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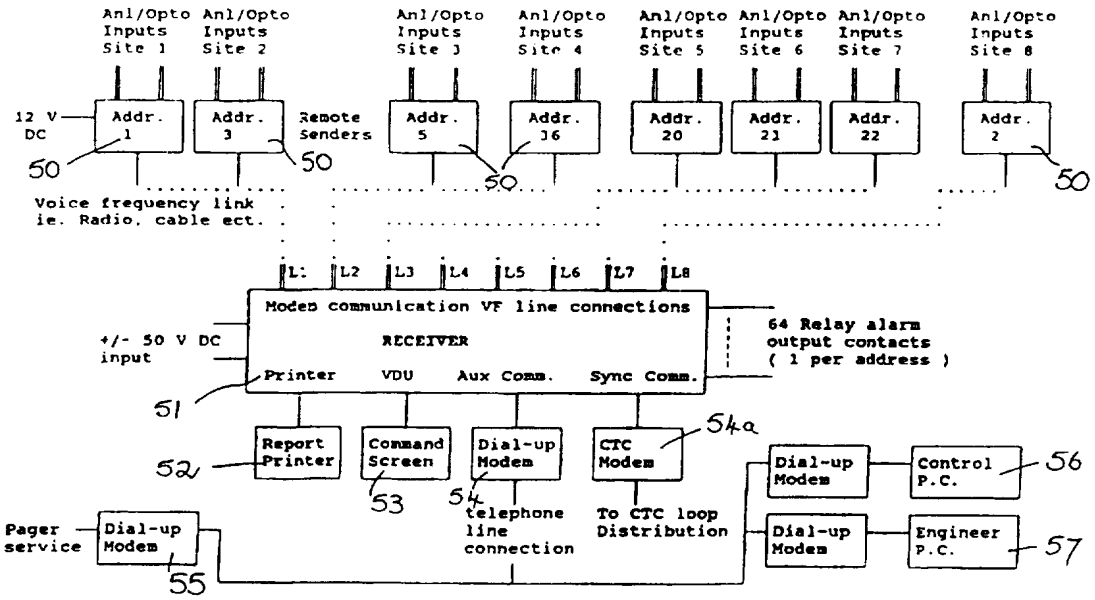

(57) Abstract

A remote monitoring system for remote monitoring of field equipment. The system has one or more sender units (50) for monitoring field equipment and transmitting a multiword message to a receiver unit (51). The receiver unit being capable of communicating with a plurality of sender units (50) and providing for telemetric communication with a control station, outputs information to a computer (56, 57), a printer (52), a pager (55) and generates alarm signals.

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REMOTE MONITORING SYSTEM

THIS INVENTION relates to a system for the remote monitoring of field equipment. In particular, the invention relates to a system for the remote monitoring of railway field equipment such as level crossings, weather stations and dragging equipment detectors, in a continuous manner.

Items of ancillary equipment comprising a railway system can be located many kilometres, even hundreds of kilometres, from maintenance or operating centres. Such equipment is invariably automated. Constant monitoring of equipment such as level crossing equipment is required in respect of the operational status of the equipment and to provide warning of failures or potential failures. Any warning must be in sufficient time to allow any railway system control centre to take appropriate precautionary action and to advise maintenance staff. Similarly, data from monitoring equipment such as weather or flood monitoring stations and dragging equipment detectors need to be continuously received so that appropriate precautionary action can be taken.

Efficient and safe operation of a railway system is dependant on immediate action in respect of equipment failure or hazardous environmental conditions such as flooding. In addition to equipment and environmental conditions being continuously monitored, the monitoring must be such that an event requiring action is brought to the attention of maintenance or operational personnel.

It is an object of the present invention to provide a remote monitoring system which allows for the continuous monitoring of field equipment and comprises a plurality of warning or output signal modalities.

According to a broad format, the invention provides a remote monitoring system comprising:

at least one sender unit for monitoring field equipment, said sender unit being capable of transmitting a multi word message;

a receiver unit linked to said at least one sender unit and capable of individual communication with each of a plurality of sender units, said receiver unit further including interfaces for:

i) telemetric communication with a control centre

ii) on-line communication with at least one computer;

iii) on-line communication with a printer; and

iv) on-line communication with a paging

wherein a defined event message received by said receiver unit generates an alarm signal which is communicated to said control centre, said at least one remote computer, said printer, or said pager.

The system described in the preceding paragraph is particularly suited for the continuous monitoring of railway system equipment. Such equipment includes level crossings, weather monitoring stations and dragging equipment detectors. Weather monitoring stations are typically employed to monitor flooding, rail temperature or rainfall.

The linkage between a sender unit and the receiving unit is typically by transmission line or by radio. Radio linkage is particularly preferred.

A receiving unit typically receives data from up to 63 sender units.

The receiving unit advantageously includes a display such as an LED display so that incoming messages can be visually monitored. Any display preferably also has in conjunction therewith an alarm responsive to a defined event message.

Defined events which generate an alarm signal in connection with a railway system include: low battery voltage; charger fail; train speed; XSR out of correspondence; light operating for excessive time; lamps blown or not flashing; flood water at or above rail level; rail temperature above a certain level; and, rainfall above a certain level.

The following description gives examples of message configurations and preferred unit configuration and operation.

The following abbreviations are used in the drawing and hereafter:

CTC	centralised traffic control
FCR	flashing control relay
FEO	flashing light resistor
IE	infrastructure engineer
PC	personal computer

RX	receiving unit
TX	sender unit
XD_nR	crossing down relay
XSR	crossing stick relay

SENDER UNIT

The sender unit is the unit which monitors the field equipment and reports back to a receiver unit by the transmission of a multi word coded message either by direct hard wire or by radio link. The message is Keyed Frequency Shift 2.1 kHz tone, (± 300 Hz) -14 db into 300 ohms transmission at 600 baud. Bridging impedance to line is 8 kohms.

The transmission is a multi word message formatted as follows:

WORD ONE	START FRAME - This is an 8 bit word using bit 7 for parity checking.
WORD TWO	ADDRESS COMPLIMENT - This is an 8 bit word using bits 0 - 5 for coding, 6 is a bit 15 complement and bit 7 for parity checking.
WORD THREE	ADDRESS - This is an 8 bit word using bits 0 - 5 for coding, 6 is bit 15 and bit 7 for parity checking.
WORD FOUR	DATA - This is an 8 bit word using bits 8 - 14 for inputs and bit 7 for parity checking.
WORD FIVE	Data bits 1 - 7
WORD SIX	This is an 8 bit word using bits 0 - 6 to indicate relay outputs the field units current state of the output relays and bit 7 for parity checking.
WORD SEVEN	CHECK SUM. This is an 8 bit word using bit 7 for parity checking.

Each message lasts for approximately 100 milliseconds plus pre-data delay to allow the radio links to establish. The unit waits until the line is clear and then after a further period of 10 seconds it attempts to transmit the message.

The message is sent in the following sequence until an acknowledgment message is received:

a) initially four transmissions at 10 - 24 second intervals;

b) then three transmissions at 10 - 24 second intervals after a further five to six minutes has elapsed;

c) then one transmission approximately every 30 minutes or at five to six minute intervals for bit 15 = 1 (Low Voltage) until acknowledgment message is received.

The sender unit has a standard configuration for alarms which must be maintained as the Receiver unit interprets the bits received from a standard bit map.

An alterative message sequence is as follows:

a) Initially four transmissions at eight second intervals;

b) then two transmissions at eight second intervals every fifteen minutes for inputs 2, 3 and 4 or two transmissions at eight second intervals every five minutes for input 1;

c) continuously at eight second intervals until acknowledged for Dragging Equipment Detectors.

The Sender unit has a standard configuration for alarms which must be maintained as the Receiver unit interprets the bits received from a standard bit map.

The bit maps for the various applications are as follows:

LEVEL CROSSINGS

BIT ONE:	XD_nR
BIT TWO:	Lights flashing.
BIT THREE:	XSR Energised.
BIT FOUR:	Mains Supply.
BIT FIVE:	Charger Failed.
BIT SIX:	"B" Track.
BIT SEVEN:	Train speed (insufficient warning time).
BIT EIGHT:	Lamps blown or not flashing (FEO 1).
BIT NINE:	Lamps blown or not flashing (FEO 2).
BIT TEN:	Lamps blown or not flashing (FEO 3).
BIT ELEVEN.	Lamps blown or not flashing (FEO 4).

BIT TWELVE: Lamps blown or not flashing (FEO 5).

BIT THIRTEEN: Lamps blown or not flashing (FEO 6 or 7).

BIT FOURTEEN: XSR or boom fall time sequence failure.

BIT FIFTEEN: Low Battery Voltage.

WEATHER STATION SITES

BIT 1: Alarm - Rail Temperature above 58° C.
Recovery - Rail Temperature falling 55° C.

BIT 2: Alarm - Rail Temperature above 62° C.
Recovery - Rail Temperature falling 59° C.

BIT 3: Alarm - Rail Temperature above 66° C.
Recovery - Rail Temperature falling 63° C.

BIT 4: Alarm - Peak Summer temperature of more than 58°C.

BIT 5: Alarm - Rainfall exceeding 100mm/hr.
Recovery - Rainfall easing 50mm/hr.

BIT 6: Alarm - Rainfall in 1 hr greater than 100mm.
Recovery - Rainfall in 1 hr less than 25mm.

BIT 7: Alarm - Temperature sensor failure.
Recovery - Temperature sensor OK.

BIT 8: Alarm - Flood sensor not working
Recovery - Flood sensor working.

BIT 9: Alarm - Flood level rising at -1.0 Metres.
Recovery - Flood level falling at -1.2 Metres.

BIT 10: Alarm - Flood level rising at -0.4 Metres.
Recovery - Flood level falling at -0.6 Metres.

BIT 11: Alarm - Flood level rising at -0.1 Metres.
Recovery - Flood level falling at 0.2 Metres.

BIT 12: Alarm - Flood level rising at Rail Level.
Recovery - Flood level falling -0.1 Metres.

BIT 13: Alarm - Flood level rising at +0.2 Metres.
Recovery - Flood level falling at Rail Level.

BIT 14: Alarm - Flood level rising at +0.5 Metres.

Recovery - Flood level falling at +0.2 Metres.

BIT 15: Alarm - Battery voltage below 10.5 Volts.

Recovery - Battery voltage above 12 Volts.

The sender unit is programmed to respond to inputs as follows:

LEVEL CROSSINGS

BIT ONE: The Sender Unit monitors a boom arm horizontal relay XD_nR normally closed contact and if this contact is broken for longer than 20 minutes an alarm is raised back to the Receiver Unit.

A recovery message is sent when the crossing down relay front contact is made.

BIT TWO: The sender unit monitors the state of a front contact of the Flashing Control Relay (FCR). If this contact is broken for more than twenty (20) minutes an alarm is sent to the receiver unit.

A recovery message is sent when the Flashing Control relay front contact is made.

BIT THREE:

The sender unit monitors the state of a back contact of the Crossing Stick Relays (XSR). If any of the XSR's energise and remain energised for a period of time in excess of twenty (20) minutes when the lights are not flashing, an alarm is sent to the receiver unit.

A recovery message is sent when all the Crossing Stick Relays are de-energised.

BIT FOUR:

The sender unit monitors the 240 Volt supply via a 12 Volt AC plug pack. If the 12 Volt AC supply is interrupted for more than 10 hours an alarm is sent to the receiver unit.

A recovery message is sent once the 12 Volt AC supply has been restored uninterrupted for a one minute period.

BIT FIVE: The sender unit monitors a front contact of the Auto Regulator Charge Fail Relay. If this contact breaks with the 240 Volt supply available for a period of time in excess of 15 minutes an alarm is sent to the receiver unit.

A recovery message is sent once the Charge Fail Relay has re-energised for 5 minutes.

BIT SIX: The Sender Unit monitors a front contact of the Crossing (road) Track Relay. The bit is sent to the receiver unit if the track is occupied for longer than 10 minutes but no alarm is raised. Its purpose is to identify the actual crossing of a train.

BIT SEVEN:

The Sender Unit monitors the sequence of events which occur on its inputs to determine whether a train passage over the crossing has occurred. If it is determined that a train passage has taken place the Sender Unit assesses whether the approach warning time to motorists is over 15 seconds. If this warning time is less than 15 seconds, an alarm is sent to the Receiver Unit and if booms installed they must be indicating horizontal when the train enters the crossing.

BITS EIGHT - FOURTEEN

The Sender Unit monitors up to seven flashing light resistors for voltage drop between 0.18 Volts and 3.2 Volts, the rate at which the voltage is switched and the state of the Flasher Control Relay.

Alarms are sent to the Receiver Unit if:

a) The Resistor voltage varies by more than 20% of the datum level for 6 seconds

b) The Flash rate is outside the range of 25-60 flashes per minute.

c) There is a voltage drop across a flashing light resistor when the Flasher Control Relay is energised. This alarm is raised after 5 minutes or after 4 seconds if the Flasher Control Relay has just energised.

d) The calibration switch is performed by operating the push button whilst the lights are on. The unit stores the normal values for reference.

Recovery messages are sent when these levels return to within the units datum levels.

BIT FIFTEEN:

The Sender Unit monitors its own input voltage. When this voltage falls below 10 Volts an alarm bit is sent back to the Receiver Unit.

A recovery message is sent after the voltage rises above 12 Volts.

WEATHER STATION AND DRAGGING EQUIPMENT SITES:

BIT 15: The sender unit monitors its own input voltage. When this voltage falls below 10 Volts or over 15 volts an alarm bit is sent back to the receiver unit.

A recovery message is sent after the voltage rises above 12 Volts and below 14 volts.

BITS 1 TO 14:

All inputs are monitored and alarm/recovery messages are sent to the receiver unit when the alarm/recovery levels are reached.

The messages are sent after a delay of 3 minutes for flood alarms (to prevent false alarms due to debris) and immediately the event occurs for temperature and rain fall.

The sender unit is a multiplexed unit capable of handling fifteen indication bits and seven output bits. The sender unit can accept up to

seven digital indication bits, using 10,000 Volt opto couplers which provide field isolation and acceptance of AC or DC input voltages from 5 Volts up to 70 Volts (Normally 12 Volt DC) or seven analogue inputs from between 0 to 5 Volts.

The Unit is programmed by an 8K eprom to allow flexible computation of data and apply any logic required for alarm inputs before transmission. This eprom also carries out averaging of analogue inputs before storage to the on board memory. The unit is provided with a watch dog circuit to ensure correct program operation.

The unit has an 8K memory for holding an event history of changes of state at the inputs. Data stored in the memory can be down loaded to the receiver unit directly on request. Each change of state is logged down to a minimum of one second time intervals provided by the on board timer. However, actual time and date stamps are provided by the receiver unit to ensure exact time relationship between all sites.

A maintenance timer is provided to prevent alarms being sent while maintenance is being carried out. This timer is activated by depressing a push button in the control box which starts a 60 minute alarm free period. The timer does not need to be cancelled but can be by holding the button in, as normal operation is resumed after 60 minutes. The LED on the front of the sender blinks while the timer is running.

RECEIVER UNIT

The receiver unit is a micro processor based unit which can monitor up to sixty three different field stations. The unit has three bit tables permanently installed in its software and is capable of accepting a further three tables which are input from the CPU interface These tables relate to the alarm bit allocations for level crossings, weather stations an dragging equipment detectors.

The Receiver unit communicates with its field units using a five word message which is structured as follows:

WORD ONE: START FRAME - This is an 8 bit word using bit 7 for parity checking.

WORD TWO: ADDRESS - This is an 8 bit word using bits 0 - 5 for coding, bit 6 for low voltage (bit 15) and bit 7 for parity checking.

WORD THREE: ADDRESS - complement and low voltage complement.

WORD FOUR: DATA - This is an 8 bit word using bits 0 - 6 to acknowledge inputs bits 8 - 14 data and bit 7 for parity checking.

WORD FIVE: DATA - This is an 8 bit word using bits 0 - 6 for acknowledging the current status of the field unit bits 1 - 7, and bit 7 for parity checking.

On receipt of a field message the receiver unit will acknowledge on the line from which the transmission was received once for every message received. The acknowledgment transmission by the receiver unit is a keyed 2 kHz tone of 14db into 300 ohms and a baud rate of 600 baud.

The Receiver Unit of a level crossing remote monitoring system processes the message as follows:

ONE: The new change of state is updated on the LED panel display for future integration.

TWO: The new change alarm is transmitted to a CTC computer or dial up to dark territory controllers . The CTC computer raises a Prompt on the CTC controllers panel. The controller is required to notify the relative maintenance staff of the alarm raised.

THREE: A pager message is transmitted to the responsible maintenance staff informing them of the event.

FOUR: The new change of state is sent to a printer port and is printed out. In conjunction with this an alarm is raised in the office where the printer is located. This alarm will continue to sound until cancelled.

FIVE: The new change of state is sent to the PC interfaced with the receiver unit.

The Receiver Unit will not initiate all four of the above steps unless the change of state contains an alarm status which is recognised by a "*" at the start of the message. Where the "*" is not present the receiver unit carries out the LED update, sends the change to the local computer interface and to the printer, but no audible alarm is initiated and no transmission is made to the CTC controller or pager.

Processing of the message by the Receiver Unit of a weather stations system is as follows:

ONE: The change of state is updated on the LED panel display for future integration.

TWO: The change of state is sent to the Train Controllers panel via a dial up modem link in Dark Territory, or to the CTC computer either direct through a communications port.

THREE: The change of state is sent to the Infrastructure Engineer via a dial up modem link through a pager service. The pager will display the alarm state for the site concerned.

FOUR: The change of state is sent to the Infrastructure Engineers computer using a dial up modem.

The receiver unit will not initiate all four of the above steps unless the change contains an alarm state which is recognised by a "*" at the start of the message. Where the "*" is not present the receiver unit carries out the LED update only. The alarms sent to Dark Territory controllers is configured in a separate table.

When an event history is required from a field station, the receiver unit will request the last forty-four changes of state at the field sender unit. The history is printed out using the bit change text messages contained in the Table for the relative site. The receiver unit also adds the date and time stamps required for the message.

The receiver unit can also obtain a full history of 770 events from the field station. Due to time taken to obtain a full report back from the

sender unit these reports are transmitted at a specified time when the system usage is minimal. This report contains the sites text messages and is time and date stamped by the receiver unit.

The receiver unit polls the individual sender units once every day after midnight. If a sender unit fails to transmit a reply the Station OK LED on the LED panel is turned off and a message is sent to the printer. Sender units can be checked at any time by request to prove the communication link and the operation of the unit.

Alarms are typically identified in four ways (L.E.D. indications, controller prompts, paging the Infrastructure Engineer and updating the Infrastructure Engineers Computer) which reduces the possibility of an alarm going undetected. To provide added security, the sender unit will keep trying to raise alarms until they are acknowledged by the receiver unit.

So that the invention may be better understood, a monitoring system will now be exemplified with reference to the drawings briefly described hereunder.

FIGURE 1 is a block diagram of a transmitter or sender unit according to an embodiment

FIGURES 2A and 2B show a block diagram of a receiver unit according to an embodiment of the invention;

FIGURE 3 is a detailed block diagram of the sender unit of Figure 1;

FIGURE 4 is a detailed block diagram of the receiver unit of Figure 2;

FIGURE 5 is a further detailed block diagram of part of the receiver unit of Figure 4;

FIGURE 6 is a detailed block diagram of receiver modem configurations in the receiver unit;

FIGURE 7 is a detailed receiver block diagram;

FIGURES 8A, B and C show a detailed circuit diagram of part of the sender unit of Figure 1;

FIGURE 9 is a detailed circuit diagram of a digital input circuit of

the sender unit;

FIGURE 10 is a detailed circuit diagram of an analog input circuit of the sender unit;

FIGURE 11 is a detailed relay output circuit of the sender unit;

FIGURE 12 is a detailed display circuit of the sender unit;

FIGURES 13A and B show a detailed circuit of part of the receiver unit;

FIGURES 14A, B and C show a further detailed circuit of part of the receiver unit;

FIGURE 15 shows a further detailed circuit of part of a receiver unit;

FIGURES 16A, B and C show a detailed circuit diagram of connection circuitry for modems in the receiver unit;

FIGURE 17 is a detailed circuit diagram of a modem interface module which is included in the receiver unit;

FIGURES 18A and B show a detailed circuit diagram of a serial driver array circuit;

FIGURES 19A and B show a detailed circuit diagram of a modem connection circuit;

FIGURES 20A and B show a detailed circuit diagram of an auxiliary relay circuit; and,

FIGURE 21 is a detailed circuit diagram of an alarm output driver module.

Figure 1 shows a block diagram of a transmitter or sender unit. The unit has a CPU/modem module 30 with the modem providing its output to a transmission link such as a line, voice frequency link or a radio link. The module 30 receives digital inputs from block 31 and analog inputs from block 32. A display 33 is coupled to module 30 to provide a visual indication of the status of the sender unit. A plurality of similarly constructed sender units may be present in a system of the invention.

Figures 2A and B show a block diagram of a receiver unit for receiving and processing signals received from a plurality of sender units like that shown in Figure 1. The receiver unit has a central processor unit

CPU 35 to which is coupled a modem bank 36 for coupling signals received from the sender units to the CPU 35. The bank 36 also allows control and acknowledge signals to be sent to the sender unit.

The CPU 35 provides control signals to an alarm output module 37 so that alarm conditions detected by the system may be displayed and reported. A switchbank 38 is coupled to the CPU 35. Display 39 indicates the status of the various received signals supplied to the CPU 35. A power supply including a DC/DC converter 40 is shown to the left of CPU 35 in Figure 2.

Figure 3 shows a detailed block diagram of the sender unit of Figure 1. Analog inputs are supplied to A/D converter 41 whilst digital inputs are applied to opto isolator/buffer module 42. The CPU 30 has ROM (or EPROM) and RAM memory modules 43, 44. A watchdog timer 45 periodically checks for proper operation of the CPU 30. Status display 33 in this instance is a LED display. Control relay latch and driver module 46 is coupled to CPU 35. Modem 47 allows CPU 30 to transmit signals to a receiver unit.

Figure 4 shows a detailed block diagram of a receiver unit and eight separate sender units 50. These units 50 transmit their signals in any suitable fashion such as, for example, over a voice frequency link, radio link or cable link. The receiver unit has a main block 51 which receives eight inputs and provides 64 relay alarm outputs, controls a printer 52 and monitor 53, provides a control signal for a dial up modem 54 to operate pager 55 and sends signals to two computer workstations 56, 57. Block 51 also provides for control of CTC modem 54a for transmitting information to a Centralised Traffic control location. Workstations 56 and 57 allow remote monitoring of conditions detected by the receiver.

Figure 5 is a further block diagram of part of a receiver. This block diagram shows that the receiver has a CPU 35 whose function is monitored by a watchdog timer 45. Outputs 0, 1 from the CPU 35 are employed to poll the display and the relay control decoder 60. Decoder 60 controls the 8 bit latches 61. Display 62 is controlled by drivers 63 and

latch 64. Latch 64 also controls the 8 bit latches 61. Display select switches 65 correspond to single pole switch S1 and the switchbank 38 shown in Figure 2B. The single pole switch, when in the position shown in Figure 2 allows signals from a sender unit to be displayed by the display. When the switch is in the other position, the receiver may be used to send control signals to the sender units. The switchbank of Figure 2 functions to supply signals from a selected 16 sites at which sender units are located to allow that group of 16 to be displayed. Different switching combinations possible by the switch bank allows the display to selectively display different groups of signals from other groups of 16 sites.

In Figure 5, the latches 61 control alarm relays. The CPU 35 also provides a station alarm output and allows that alarm to be cancelled.

The system includes a plurality of modems associated with the receiver unit. As shown in Figure 6, eight such modem lines are present. Figure 2 shows eight modem lines coupled to the CPU 35. These eight modems each provide outputs as shown which allow signals from the transmission link to be coupled to the CPU data bus as shown.

Figure 7 shows detail of a receiver unit. CPU 35 is coupled via an 8 bit bus to a plurality of ports. Asynchronous port 70 allows the eight modems of Figure 5 to be coupled to the CPU. Asynchronous port 71 allows the printer 52 and VDU or command screen 53 (see Figure 4) to be connected to the CPU 35. Asynchronous port 72 allows dial-up modem 54 (see Figure 4) to be connected to the CPU. Synchronous port 73 allows the Centralised Traffic Control (CTC) modem (see Figure 4) to be connected to the CPU. Each of the ports 71, 72, 73 have RS232 drivers coupled to them. A display and relay alarm port 74 is coupled to the 8 bit bus.

Figures 8A, B and C show greater detail of a sender unit. The unit has a CPU 30 coupled to a latch U21 and an address decoder U22. A further latch U26 allows CPU 30 to provide output signals for a purpose described below. Connector JP13 allows the CPU 30 to receive digital input signals and to output signals to the display. Transistor Q4 and

associated components function as a watch dog timer which monitors the operation of CPU 30 and is able to reset CPU 30 if required. ROM (or EPROM) memory U23 and RAM memory U25 are coupled to CPU 30.

Inputs AN0 to AN7 are for analog input signals. An A/D converter U24 receives these signals and applies them to the CPU 30.

Figure 9 shows a digital input circuit. Connector J19 applies digital signals to OPTO isolators, only one U27 of which is shown. Schmidt triggers couple the output of the OPTO isolators to connector JP14 which in turn is coupled to connector JP13 in Figure 8C and to connector JP15 in Figure 12. Seven OPTO isolator circuits extend between connectors J19 and UP14 but only one has been shown in complete detail in this figure. The remaining six of these circuits are identical to the one shown and are represented diagrammatically by block B1.

Figure 10 shows an analog input circuit. Connector J20 receives analog inputs and each one of seven of these inputs is filtered in a respective one of the seven filter networks. One of the analog inputs is not filtered but is simply voltage divided and made available as ANO. This allows the +12V battery voltage to be monitored as one of the analog inputs. As mentioned, Figure 10 has seven filter circuits identical to the three illustrated extending between connector J20 and providing their outputs at terminals AN1, AN2 and AN7. The four filter circuits are identical to the ones shown and are represented diagrammatically by block B2.

Figure 11 shows a relay output control circuit which may form part of a sender unit. The inputs RLY0 to RLY6 are derived from the terminals D0 to D6 provided by latch U26 in Figure 8. These inputs control respective relays RLY1 to RLY7 for switching associated contacts to allow a sender unit to switch equipment at the site where the sender unit is located. Relay outputs are available at connector J21. Only one of the relay circuits is shown in detail. The remaining six are shown diagrammatically by block B2.

Figure 12 shows detail of a status display circuit. Connector JP15 is coupled to connector JP13 in Figure 8. Counter U28 controls latching of

latches U29 and U30 which allow CPU 30 (see Figure 8) to activate an LED display consisting of diodes LED1 to LED15. These LED's provide the display 32 shown in Figure 1.

Figures 13A, B and C show more detail of a receiver unit.

CPU U1 (or 35 as it is annotated in Figure 2) has ROM (or EPROM) memory U2 and RAM memory U3 coupled to it. Counter U4 and crystal XTAL1 provide a clock for controlling modem operation for the modems associated with the receiver. Data bus D (0-7) extending from the CPU U1 is coupled to the memory U2 and U3 and to other parts of the receiver unit.

Figures 14A, B and C show a further detailed circuit diagram of part of a receiver unit. The data bus D (0-7) from Figures 13A, B and C is coupled to a port interface circuit U5. Watchdog timer consisting of schmidt triggers U7A&B and other components provide a reset signal for CPU U1 in Figure 13. Switchbank J5 and switch J6 (or 38 and S1 as annotated in Figure 2B) are coupled to the port interface circuit U5. Drivers U7 and U8 extend between circuit U5 and connector JP2 to which a display is connected. Driver U9 is located between circuit U5 and connector JP3 to which alarm outputs are supplied. Driver U6 is connected between connector JP1 and the circuit U5 and supplies signals for operating a display.

Figure 15 shows data bus DBUS coupled to a driver U12. Address signals are coupled to a driver U13 and directly to four connectors Z1 as shown. Block B4 shows diagrammatically the other three connectors Z1. Modems (eight in number) are connected to these connectors with two per connector.

Figures 16A, B and C show a port configuration for the receiver unit. Port J8 is a printer serial port for printer 52 in Figure 4. Port J9 is a VDU serial port for the command screen 53 in Figure 4 Port J10 is an auxiliary serial port to which the dial up modem 54 in Figure 4 is connected. The last port J11 provides a synchronous serial port to which the centralised traffic control modem 54a in Figure 4 is connected. The

connector Z2 A-B of Figure 16 connects to connector Z6 A-B in Figure 18 while connector Z3 is coupled to connector Z5-B in Figure 18. Address signals are applied to the logic circuit consisting of three inverters and two NAND gates and the final inverter conveys the signal to connector Z3.

In Figure 17, connector Z4 is coupled to Z1 in Figure 15. Four circuits like that shown in Figure 17 are employed in the receiver unit - one for each of three connectors in block B4 corresponding to connector Z1 in Figure 15. Modem port circuits (ASCI drivers) U14 and U15 are located between connector Z4 and JP4. Two modems are connected to JP4. The circuit of Figure 17 is a modem interface module.

Figures 18A and B show a serial peripheral driver array. Three drivers U16, U17 and U18 extend between connectors Z5 - A/B and Z6 - A/B.

Figures 19A and B show connectors JP7 to JP11 and terminals to which modems are connected. In these figures, block B5 shows diagrammatically the additional modem terminal configurations for the further four modems not shown in detail in the figures. Connectors JP7 to Jp11 connect to respective connectors JP4 in Figure 17. Connector J12 to J14 allow the modems to be connected to a communication link such as a voice frequency or radio link.

Figures 20A and B show an auxiliary relay circuit of the receiver unit. Connector J12 extends to connector JP3 in Figure 14 and allows alarm signals to be coupled to the relay circuit of Figure 20. Relay modules M1 and M2 are shown in detail and provide terminals to which a relay driver module (see Figure 21) may be connected. Blocks B6, B7 and B8 each shown diagrammatically two further relay modules identical to the two modules M1 and M2 shown in detail. These modules provide output COM and ALM1-8 for operating alarms.

Connectors J16, J17 and J18 may be coupled to a cable, radio link or other link for conveying alarm signals to a remote location.

Figure 21 shows a detailed circuit diagram of a decoder/driver module. Eight such modules are present in the receiver unit of the

invention. Each module receives inputs CLR RD0-7 from CPU U1 in Figure 13. Latch U9 couples these signals to eight transistor/relay control circuits, of which only one is shown. The others are configured in a like fashion and are shown diagrammatically by block B10. The transistor controls a relay and contacts as shown. The module provides outputs COM and ALM1-8 signals.

The remote monitoring system monitors or controls equipment which by nature is infrequent in its use. The system exchanges data between the sender units and the receiver unit on a change of state basis. That is, the receiver unit does not continually poll the sender units. This allows the communication link or bearer to be shaved with existing services such as a voice radio link.

The capacity of the system is limited to 63 remote sender units per receiver unit. The receiver unit has 8 modem inputs and the 63 sender units can be on any of these 8 lines with no more than 16 sender units on any one modem line.

Alarm signals at the sender unit pass through software timers in the computer which forms part of the unit before transmission to the receiver unit. Timeouts can be configured for 0 to 1 and 1 to 0 state change from 0 sec to 18 hours in 1 sec steps.

Upon receipt of a change of state at the receiver unit, the data is displayed in the receiver unit display. The display is 16 addresses wide, switchable between address groups. As well as the 14 external indication bits the status of the 12 volt supply to the sender unit is indicated.

The receiver unit sends a printout to the printer and the display at the receiver unit upon receipt of a change of address from the sender unit. The auxiliary RS232 port is used to send information to a pager and remote computers via dialup modems. The Sync data port communicates with a centralised traffic control (CTC) computer.

The ROM memory is provided by EPROM chips which store all configurations so that if a system fails, these chips may be transferred to a replacement system. All RAM memory is non-volatile and has battery

backup for which power is turned off.

SENDER UNIT PROTOCOL

In each sender unit transmission time is 150mS plus link opening time. The carrier detect input must be free for 10 sec before a transmission will be sent or if delayed for 15 minutes the transmission will be sent regardless.

All sender units are tested by an all station poll once per day. All transmissions from the sender units are acknowledged by the receiver unit irrespective of a carrier detect signal at the receiver unit. All other transmissions from the receiver unit must have a carrier detect signal free. If carrier detect signal is busy for more than 15 minutes without any breaks the receiver unit will ignore the busy input for that coms line unit a break of greater than 10 sec is detected.

If the link to the receiver unit is not operating for some reason, the sender unit will continue to send until a reply is received. The first four transmissions are sent at 10-24 sec spacings, dependent on address, then a 5-6 min break, then three more tries at 10-24 sec. If there is still no acknowledgment, a 30-31 min break occurs followed by one transmission is repeated until the link is re-established.

The receiver unit monitors transmission from sender units and if more than 16 transmissions are received in any 24 hour period from one sender unit an "excessive transmission" message is printed for that address. The counters are periodically reset.

Alarm signals will always be processed by the receiver unit once received even if a fault prevents the sender unit receiving the acknowledgment from the receiver unit.

THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:

1. A remote monitoring system comprising at least one sender unit for monitoring field equipment at a remote location, said sender unit being capable of transmitting a multi word message; a receiver unit linked to said at least one sender unit and capable of individual communication with each of a plurality of sender units, said receiver unit further including interfaces for:

i) telemetric communication with a control centre

ii) on-line communication with at least one computer

iii) on-line communication with a printer; and

iv) on-line communication with a pager;

wherein a defined event message received by the receiver unit generates an alarm which is communicated to said control centre, said at least one more computer, said printer or said pager.

2. The remote monitoring system of claim 1 wherein the or each sender unit includes a digital input circuit, an analog input circuit and a status display, a computer coupled to the circuits and the display for providing the message for transmission to the receiver unit.

3. The remote monitoring system of claim 2 wherein the sender unit includes a modem for transmitting the message from the sender unit to the receiver unit.

4. The remote monitoring system of claim 2 or 3 wherein the message from the sender unit is transmitted to the receiver unit by a voice frequency link, radio link or a direct cable or optic fibre link.

5. The remote monitoring system of claim 2 wherein the sender unit includes an interface circuit coupled to the computer and a relay output module controlled by the interface circuit whereby control signals sent from the receiver unit may control the relay module at the sender unit for controlling equipment associated with the field equipment being monitored.

6. The remote monitoring system of claim 5 wherein the interface circuit is a latch and the input to the latch is coupled to the display and digital input circuit.

7. The remote monitoring system of claim 2 wherein the sender unit includes an analog to digital converter in the analog input circuit.

8. The remote monitoring system of claim 7 wherein the analog input circuit includes a voltage divider and a plurality of filter circuits for receiving analog inputs and for supplying filtered analog signals and a voltage divided analog signal to the analog to digital converter.

9. The remote monitoring system of claim 2 wherein the digital input circuit includes a plurality of opto couplers for isolating digital signals from the computer in the sender unit.

10. The remote monitoring system of claim 1 wherein the receiver unit includes a CPU and ROM and RAM memory.

11. The remote monitoring system of claim 10 wherein the receiver unit includes, coupled to the CPU: a display, alarm output means, a plurality of modems and display select switches for controlling the mode of operation of the display.

12. The remote monitoring system of claim 10 wherein the receiver unit has eight modems.

13. The remote monitoring system of claim 12 wherein the receiver unit has a plurality of ports for the interfaces for connection to the display, for connection to the eight modems, for connection to an auxiliary dial up modem, and for connection to a CTC modem.

14. The remote monitoring system of claim 13 wherein the dial up modem is connected to the remote computer.

15. The remote monitoring system of claim 13 wherein some of the ports are asynchronous ports and some of the ports are synchronous ports.

16. The remote monitoring system of claim 11 wherein the receiver unit includes an alarm circuit for providing an audible alarm.

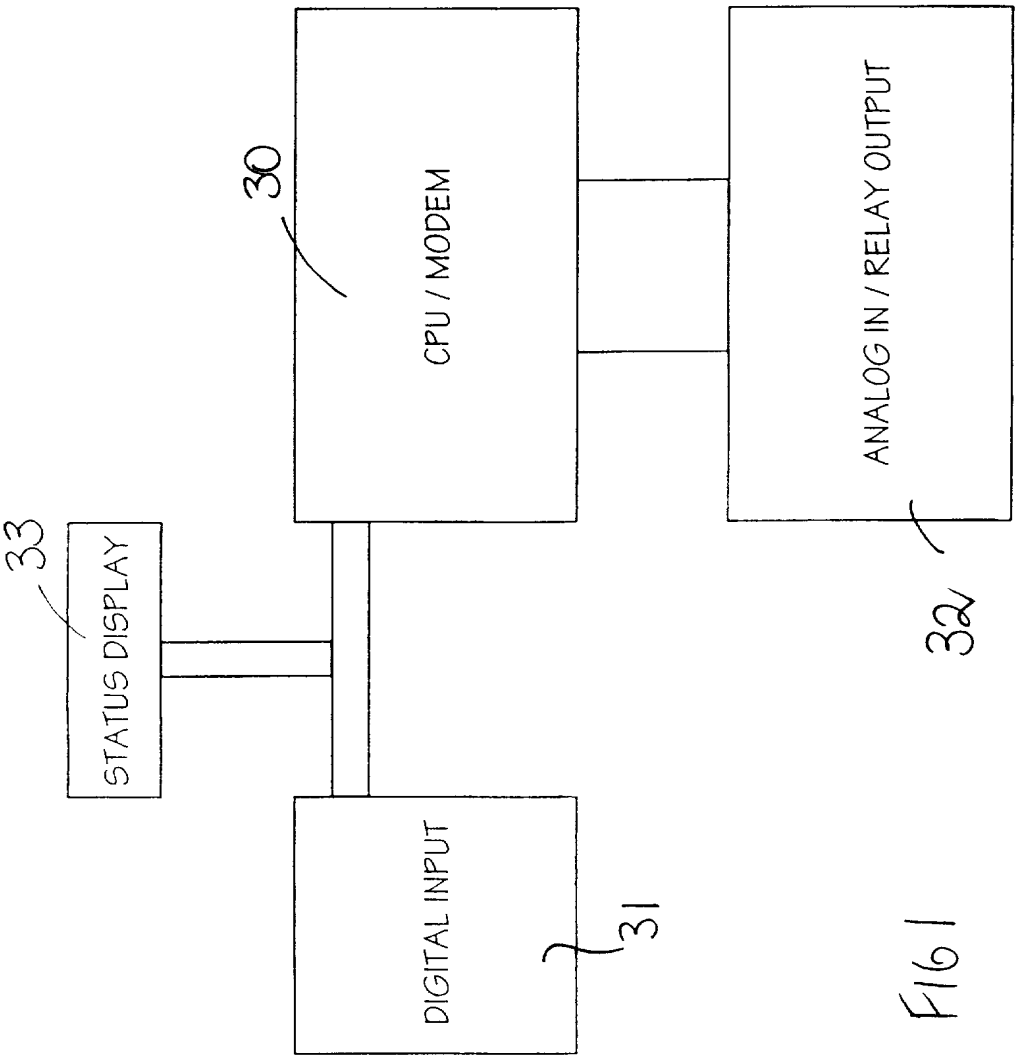
17. The remote monitoring system of claim 14 wherein the receiver unit includes a serial port driver circuit for providing the printer display, the auxiliary and the synchronous ports.

18. The remote monitoring system of claim 11 wherein the receiver circuit includes driver modules coupled to the CPU for providing alarm

outputs.

19. The remote monitoring system of claim 18 wherein the driver modules each have a relay decoder driver circuit including a plurality of relays having alarm contacts such that the CPU may switch the contacts in the relay decoder driver circuit to provide the alarm outputs.

20. The remote monitoring system of claim 12 wherein the receiver unit includes modem interface units for the modems with two said modems being connected to each said modem interface unit.


30
CPU / MODEM
ANALOG IN / RELAY OUTPUT
32
33
STATUS DISPLAY
DIGITAL INPUT
31

F16 1

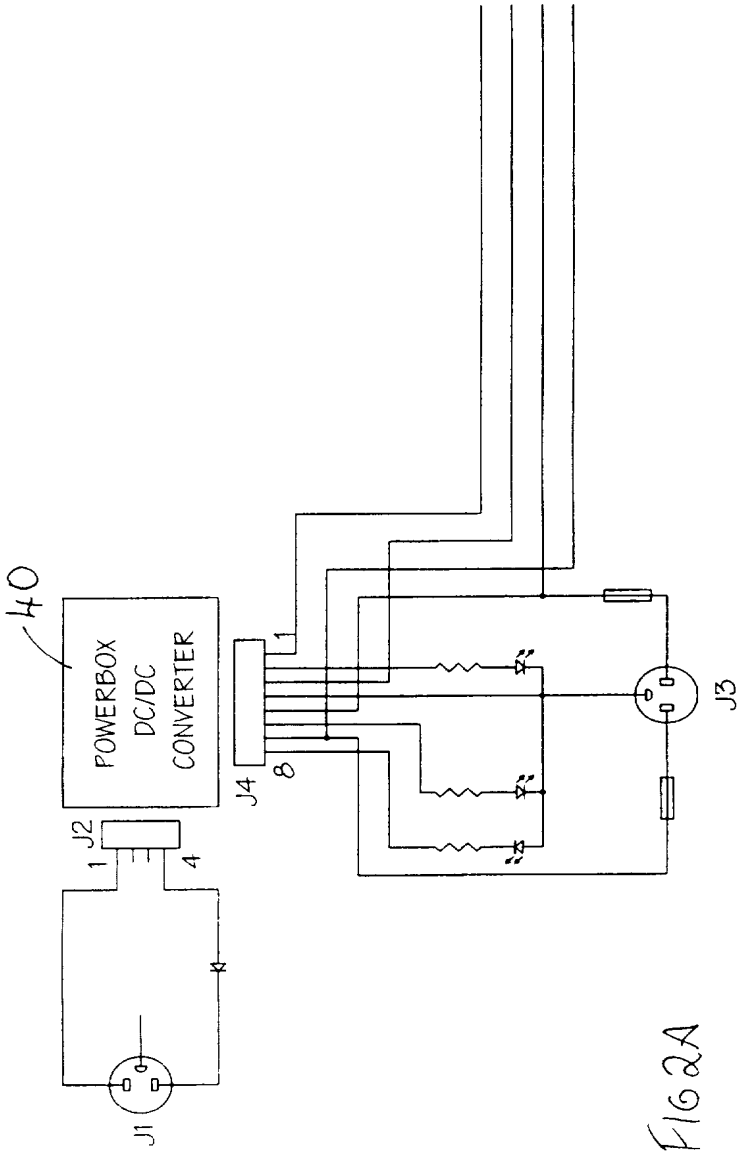


FIG 2A

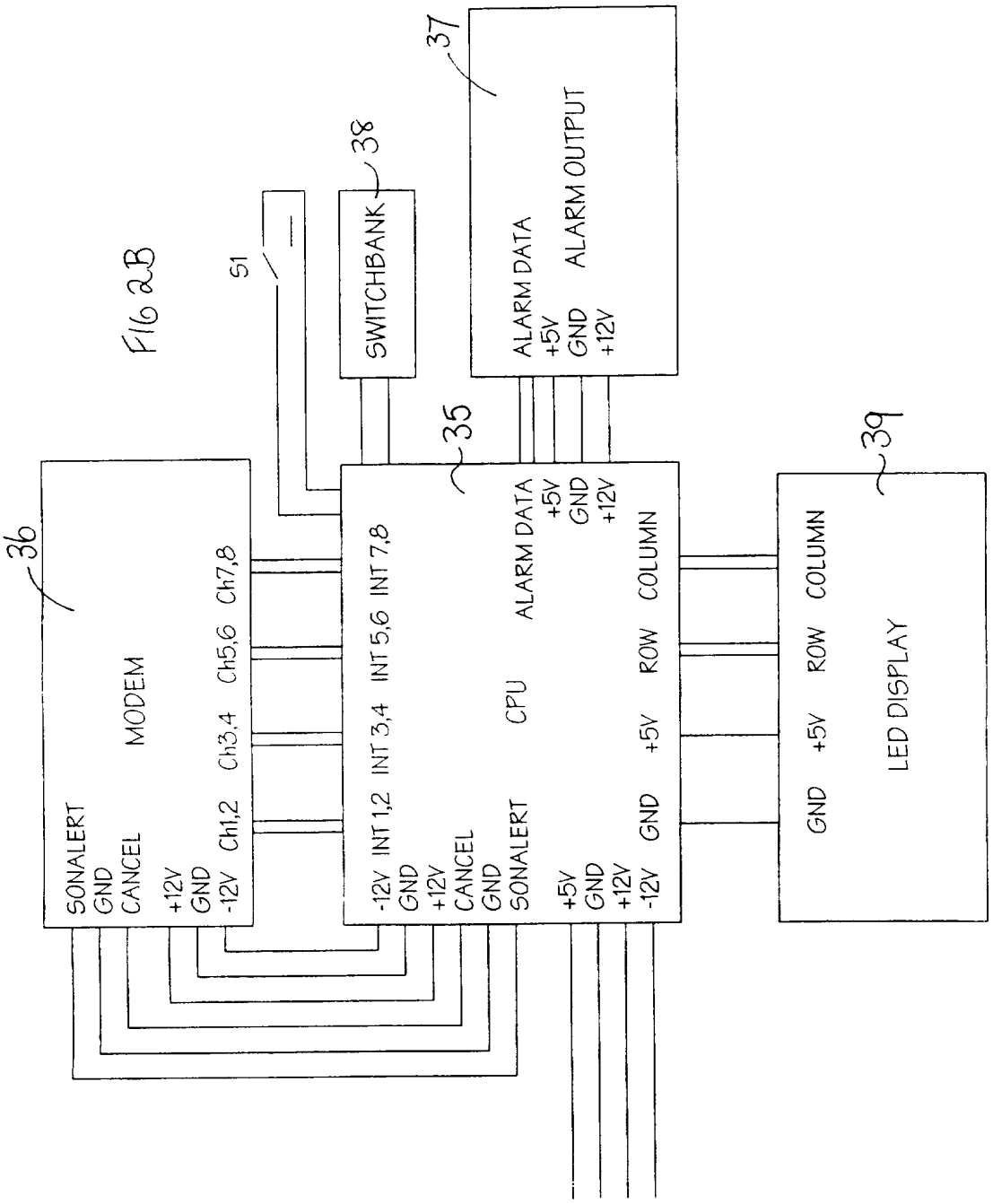
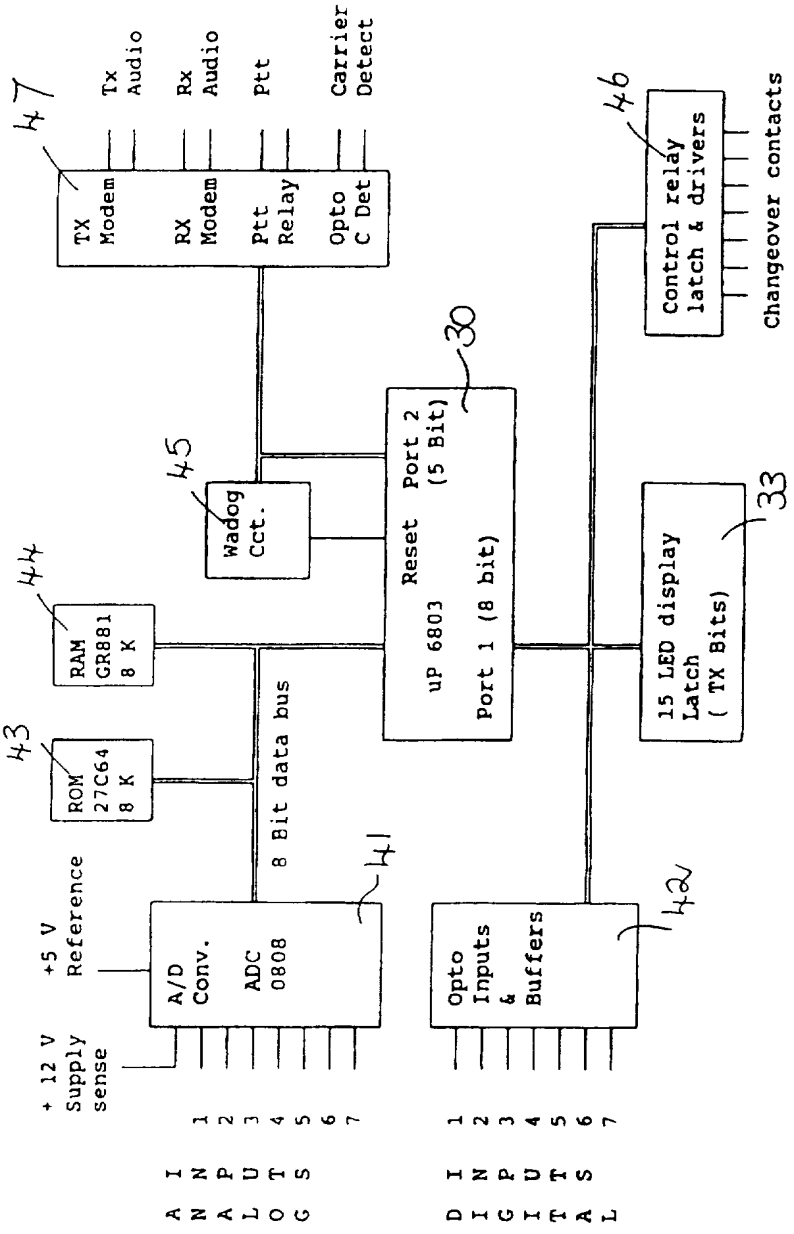
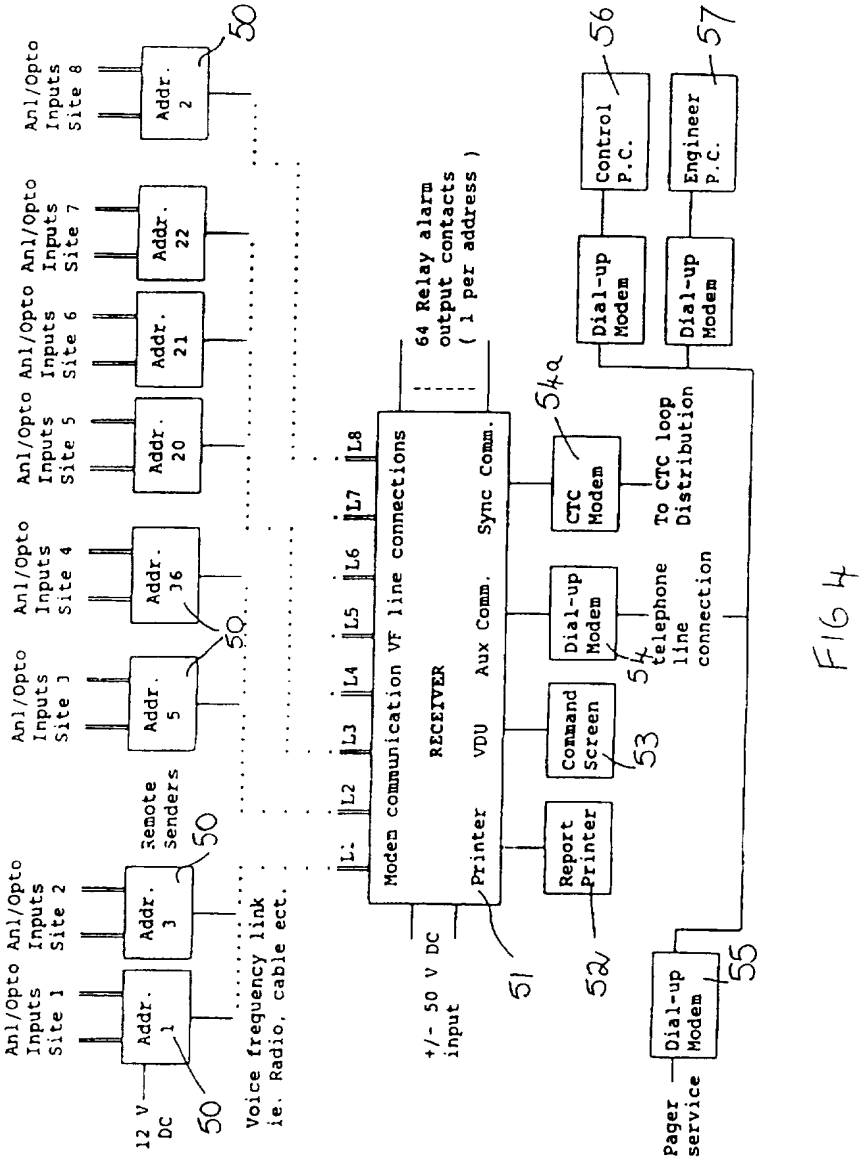


Fig 2B
36
MODEM
SONALERT
GND
CANCEL
+12V
GND
-12V
Ch1,2
Ch3,4
Ch5,6
Ch7,8
51
38
SWITCHBANK
35
CPU
-12V
GND
+12V
CANCEL
GND
SONALERT
INT 1,2
INT 3,4
INT 5,6
INT 7,8
ALARM DATA
+5V
GND
+12V
ROW
COLUMN
+5V
GND
+12V
-12V
37
ALARM OUTPUT
ALARM DATA
+5V
GND
+12V
39
LED DISPLAY
GND
+5V
ROW
COLUMN


47
Tx Audio
Rx Audio
Ptt
Carrier Detect
TX Modem
RX Modem
Ptt Relay
Opto C Det
46
Control relay latch & drivers
Changeover contacts
30
Reset
Port 2 (5 Bit)
uP 6803
Port 1 (8 bit)
45
Wadog Cct.
44
RAM GR881 8 K
43
ROM 27C64 8 K
8 Bit data bus
33
15 LED display Latch (TX Bits)
41
+5 V Reference
+ 12 V Supply sense
A/D Conv.
ADC 0808
42
Opto Inputs & Buffers
ANALOG INPUTS
1 2 3 4 5 6 7
DIGITAL INPUTS
1 2 3 4 5 6 7

F163


Anl/Opto Inputs Site 1
Anl/Opto Inputs Site 2
Anl/Opto Inputs Site 3
Anl/Opto Inputs Site 4
Anl/Opto Inputs Site 5
Anl/Opto Inputs Site 6
Anl/Opto Inputs Site 7
Anl/Opto Inputs Site 8
Addr. 1
Addr. 3
Addr. 5
Addr. 36
Addr. 20
Addr. 21
Addr. 22
Addr. 2
Remote Senders
12 V DC
Voice frequency link ie. Radio, cable ect.
Modem communication VF line connections
RECEIVER
Printer
VDU
Aux Comm.
Sync Comm.
L1
L2
L3
L4
L5
L6
L7
L8
+/- 50 V DC input
64 Relay alarm output contacts (1 per address)
Report Printer
Command Screen
Dial-up Modem
telephone line connection
CTC Modem
To CTC loop Distribution
Dial-up Modem
Control P.C.
Dial-up Modem
Engineer P.C.
Dial-up Modem
Pager service
50
51
52
53
54
54a
55
56
57

F16 4

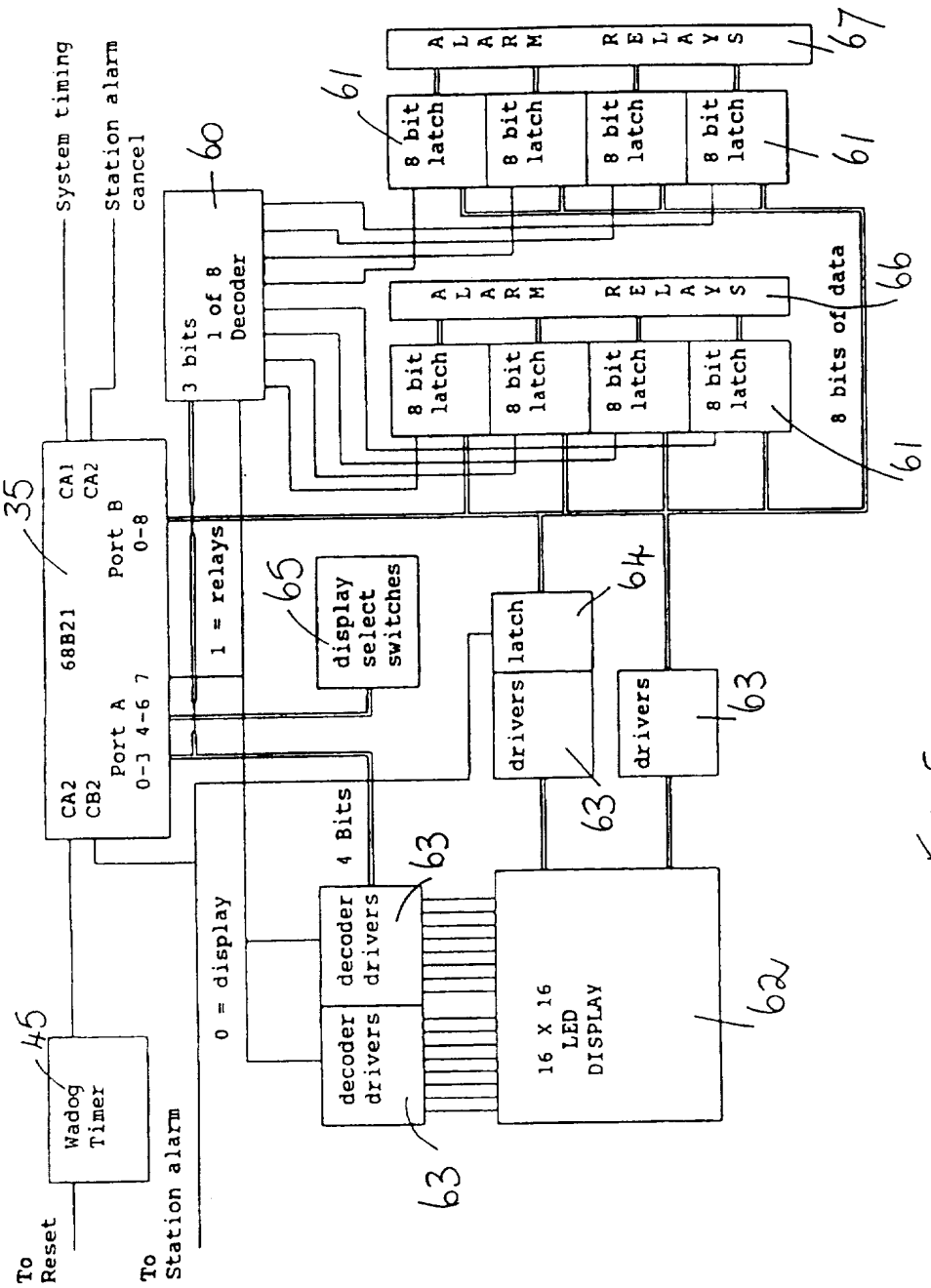
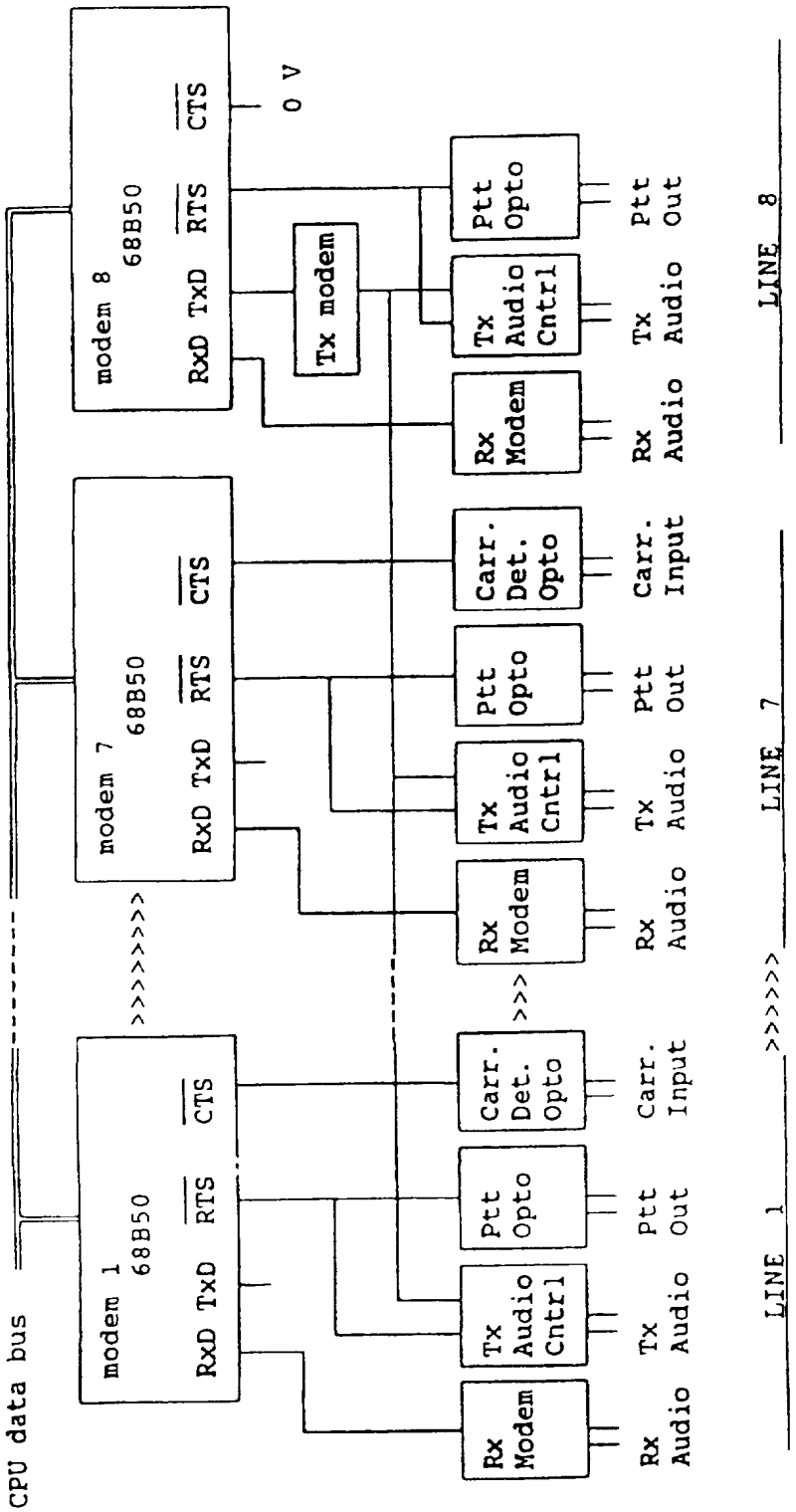
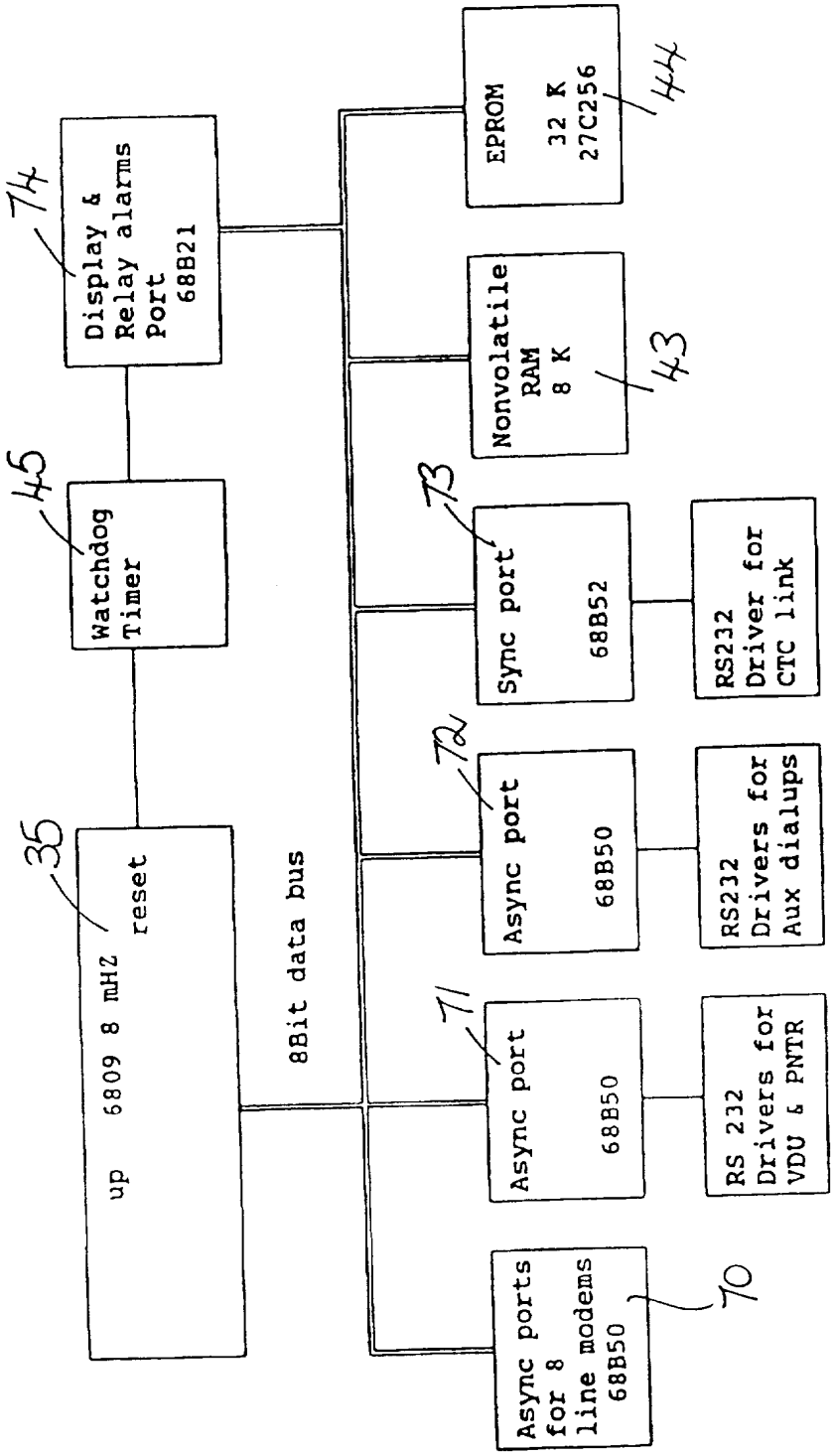

System timing
Station alarm cancel
60
3 bits
1 of 8
Decoder
61
8 bit latch
8 bit latch
8 bit latch
8 bit latch
ALARM RELAYS
67
8 bits of data
66
35
CA1
CA2
68B21
Port B
0-8
Port A
0-3 4-6 7
CA2
CB2
1 = relays
0 = display
65
display select switches
64
latch
drivers
63
drivers
63
4 Bits
decoder drivers
decoder drivers
63
16 X 16
LED
DISPLAY
62
45
Wadog Timer
To Reset
To Station alarm

FIG 5


CPU data bus
modem 1
68B50
RxD TxD RTS CTS
modem 7
68B50
RxD TxD RTS CTS
modem 8
68B50
RxD TxD RTS CTS
0 V
Tx modem
Rx Modem
Tx Audio Cntrl
Ptt Opto
Carr. Det. Opto
Rx Audio
Tx Audio
Ptt Out
Carr. Input
LINE 1
LINE 7
LINE 8

F16 6


74
Display & Relay alarms Port 68B21
45
Watchdog Timer
35
up 6809 8 mHZ reset
8Bit data bus
EPROM 32 K 27C256
44
Nonvolatile RAM 8 K
43
73
Sync port 68B52
RS232 Driver for CTC link
72
Async port 68B50
RS232 Drivers for Aux dialups
71
Async port 68B50
RS 232 Drivers for VDU & PNTR
Async ports for 8 line modems 68B50
70

F16 7

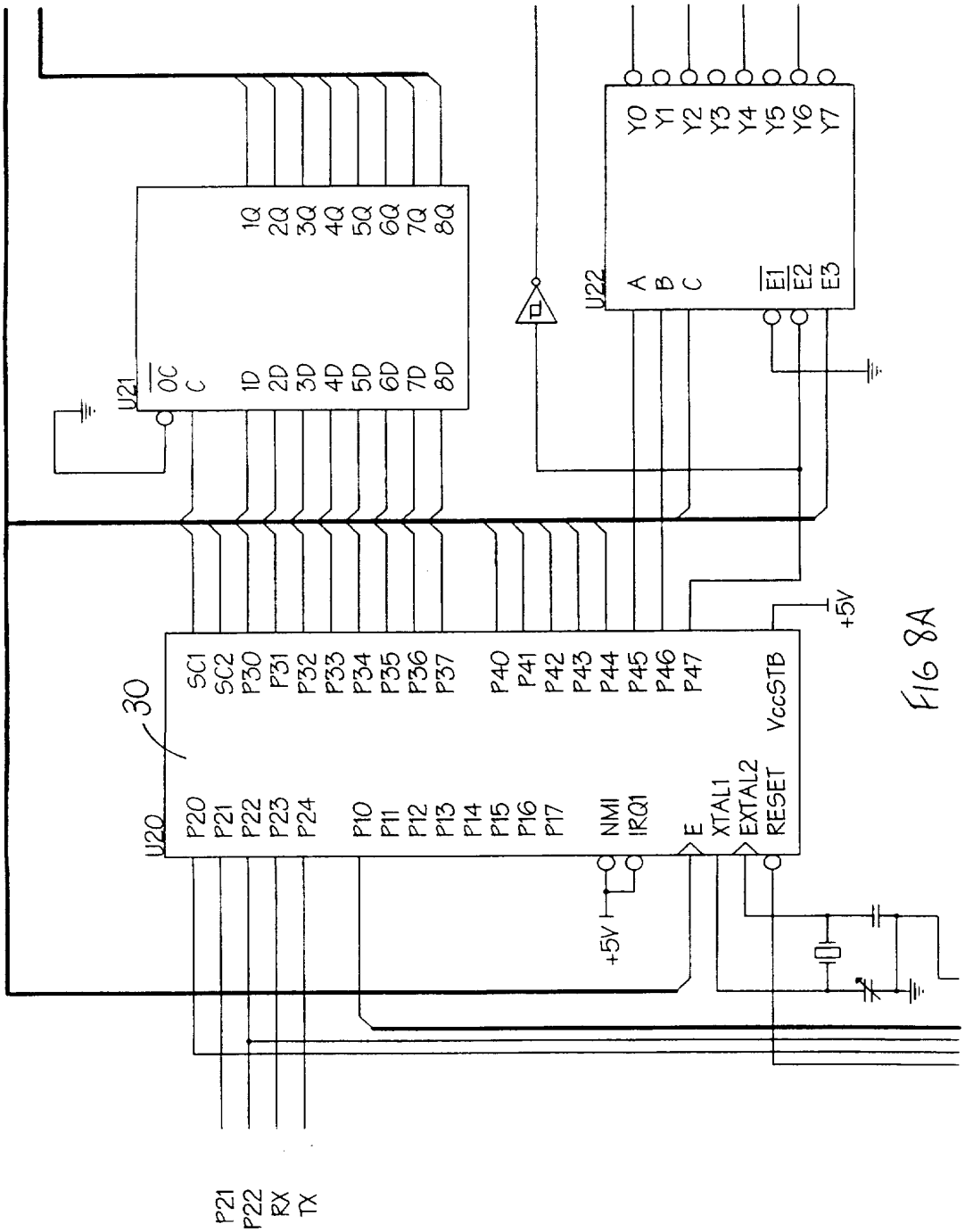

U21
OC
C
1D 2D 3D 4D 5D 6D 7D 8D
1Q 2Q 3Q 4Q 5Q 6Q 7Q 8Q
U22
A B C
E1 E2 E3
Y0 Y1 Y2 Y3 Y4 Y5 Y6 Y7
+5V
30
U20
SC1 SC2 P30 P31 P32 P33 P34 P35 P36 P37
P40 P41 P42 P43 P44 P45 P46 P47
VccSTB
P20 P21 P22 P23 P24
P10 P11 P12 P13 P14 P15 P16 P17
NMI IRQ1
E
XTAL1 EXTAL2 RESET
+5V
P21
P22
RX
TX

Fig 8A

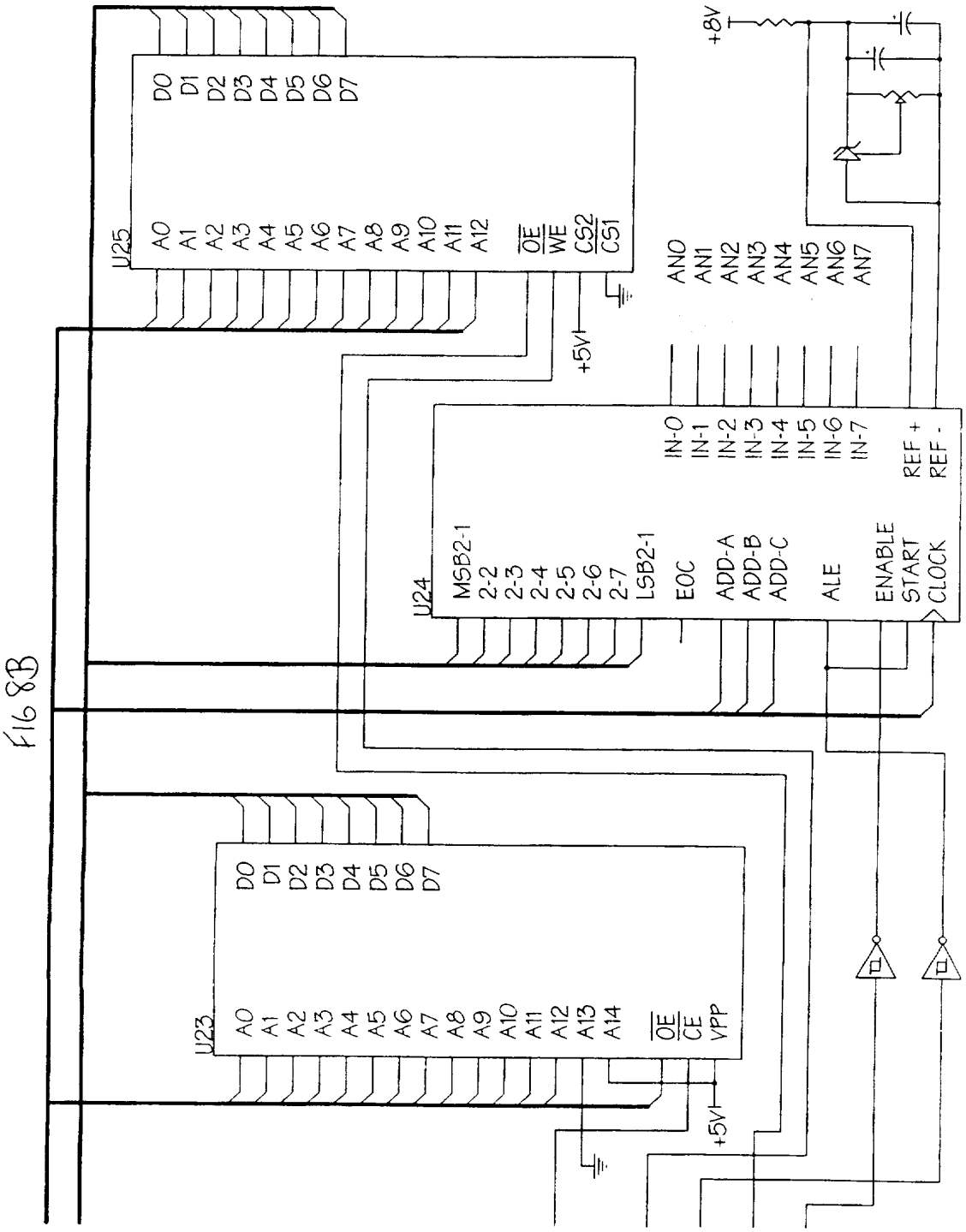

U25
D0 D1 D2 D3 D4 D5 D6 D7
A0 A1 A2 A3 A4 A5 A6 A7 A8 A9 A10 A11 A12
OE WE CS2 CS1
+5V
+8V
AN0 AN1 AN2 AN3 AN4 AN5 AN6 AN7
U24
IN-0 IN-1 IN-2 IN-3 IN-4 IN-5 IN-6 IN-7
REF + REF -
MSB2-1 2-2 2-3 2-4 2-5 2-6 2-7 LSB2-1
EOC
ADD-A ADD-B ADD-C
ALE
ENABLE START CLOCK
U23
D0 D1 D2 D3 D4 D5 D6 D7
A0 A1 A2 A3 A4 A5 A6 A7 A8 A9 A10 A11 A12 A13 A14
OE CE VPP
+5V

Fig 8B

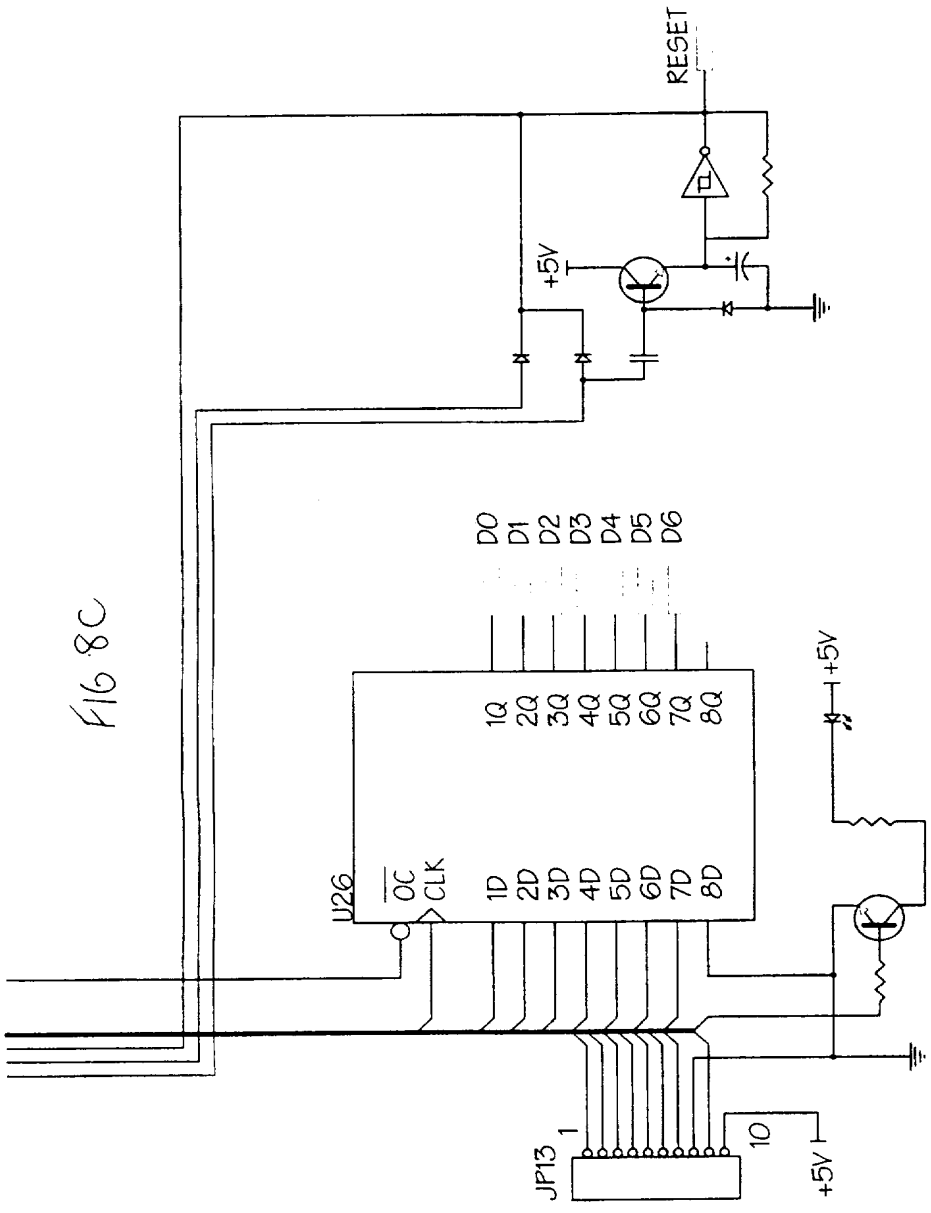

RESET
+5V
D0
D1
D2
D3
D4
D5
D6
1Q
2Q
3Q
4Q
5Q
6Q
7Q
8Q
U26
OC
CLK
1D
2D
3D
4D
5D
6D
7D
8D
+5V
JP13
1
10
+5V

Fig 8C

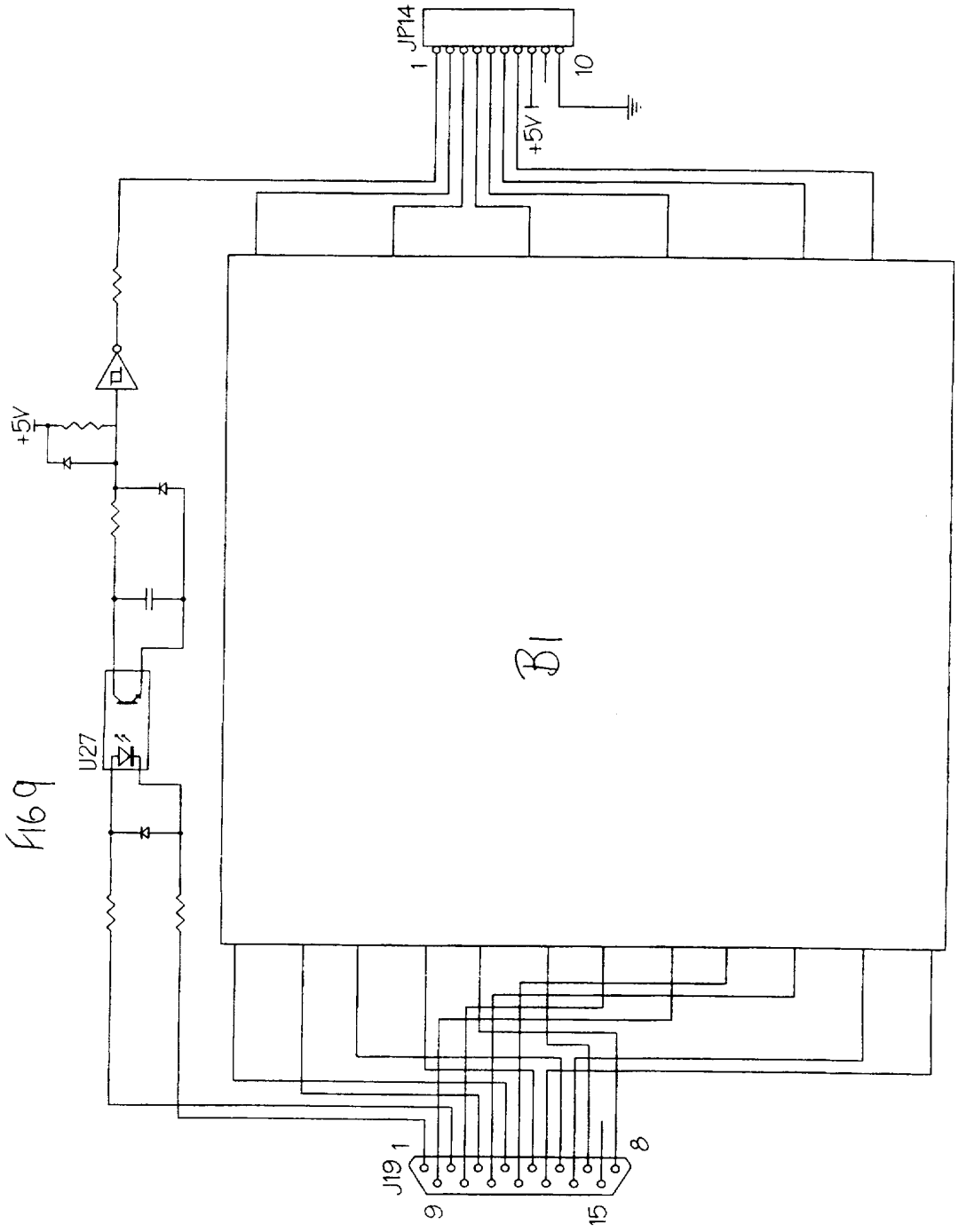


Fig 9

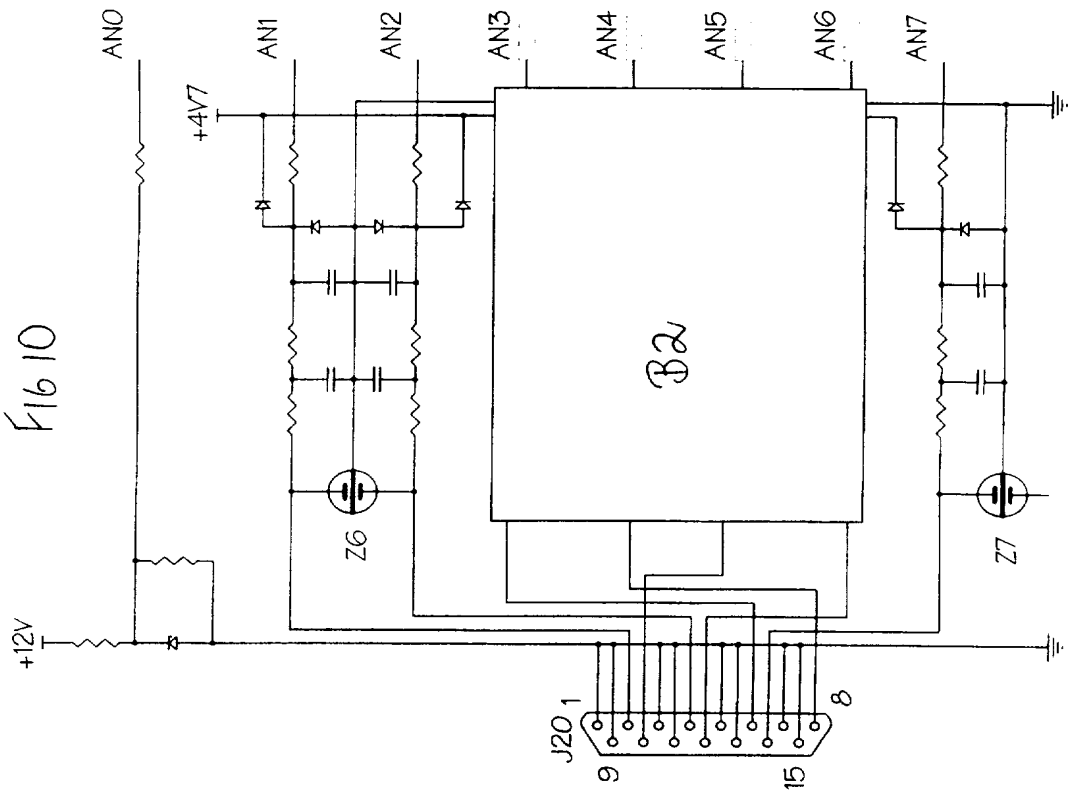


Fig 10

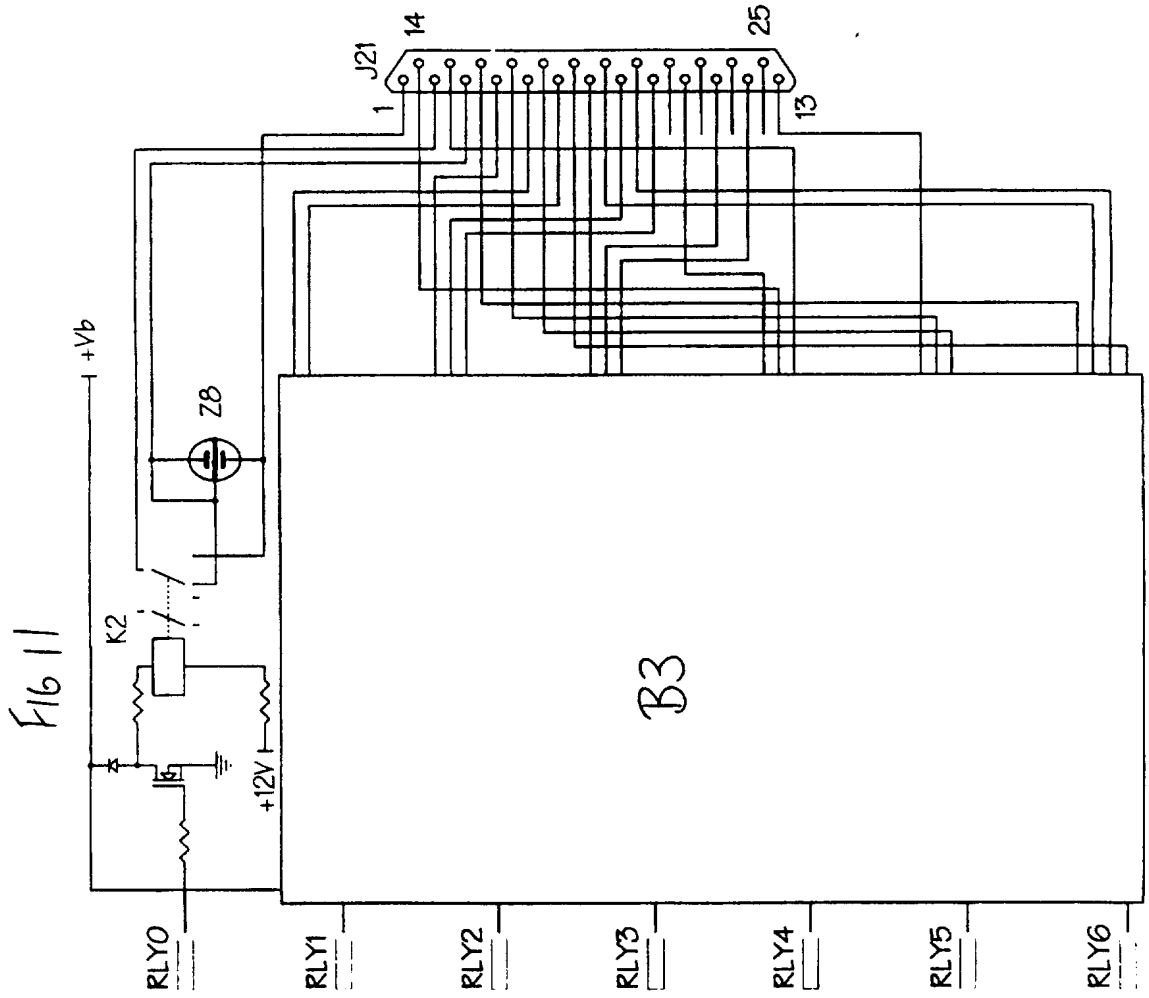


Fig 11

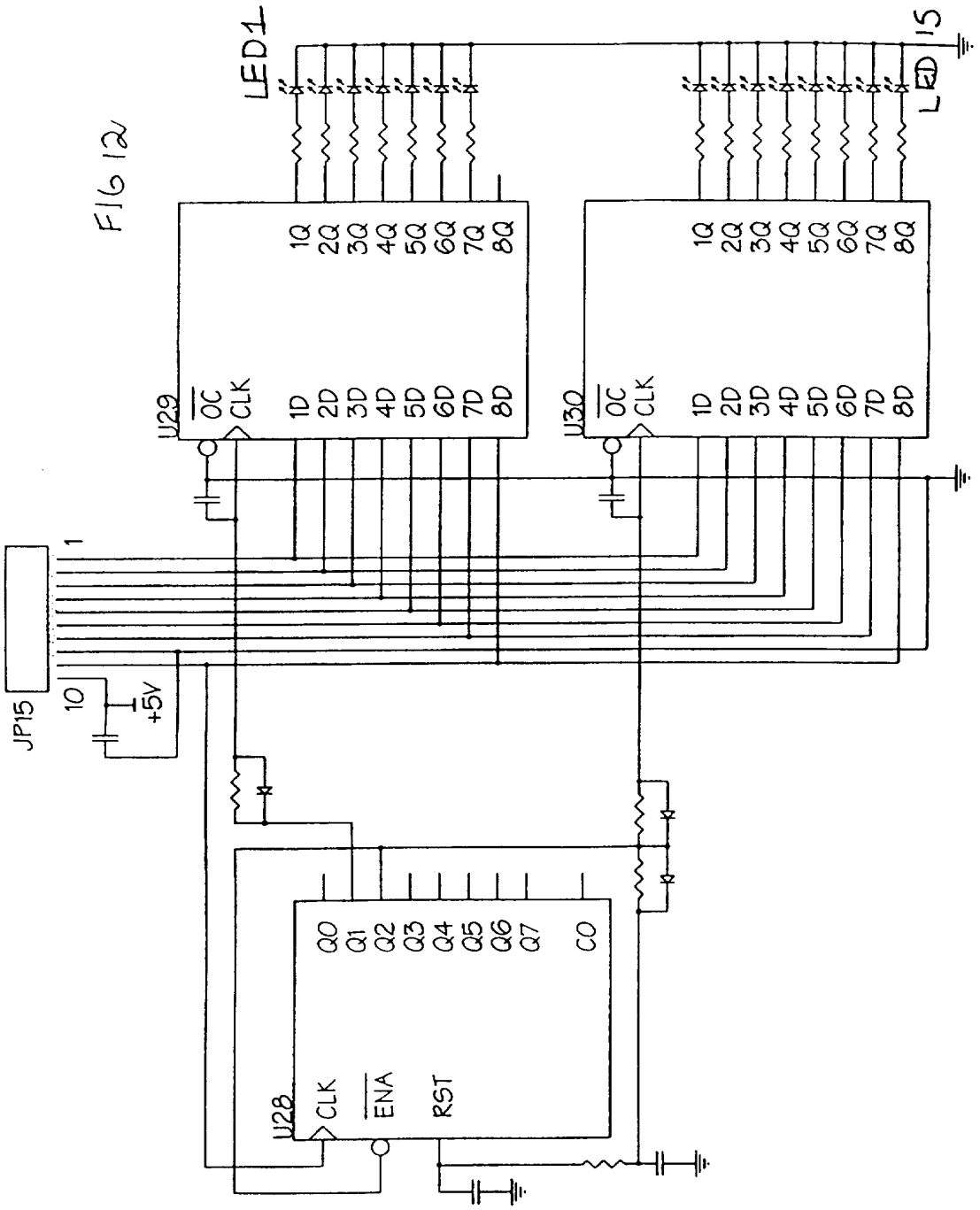

LED1
LED15
U29
U30
U28
JP15
+5V
1Q
2Q
3Q
4Q
5Q
6Q
7Q
8Q
1D
2D
3D
4D
5D
6D
7D
8D
OC
CLK
Q0
Q1
Q2
Q3
Q4
Q5
Q6
Q7
CO
ENA
RST

Fig 12

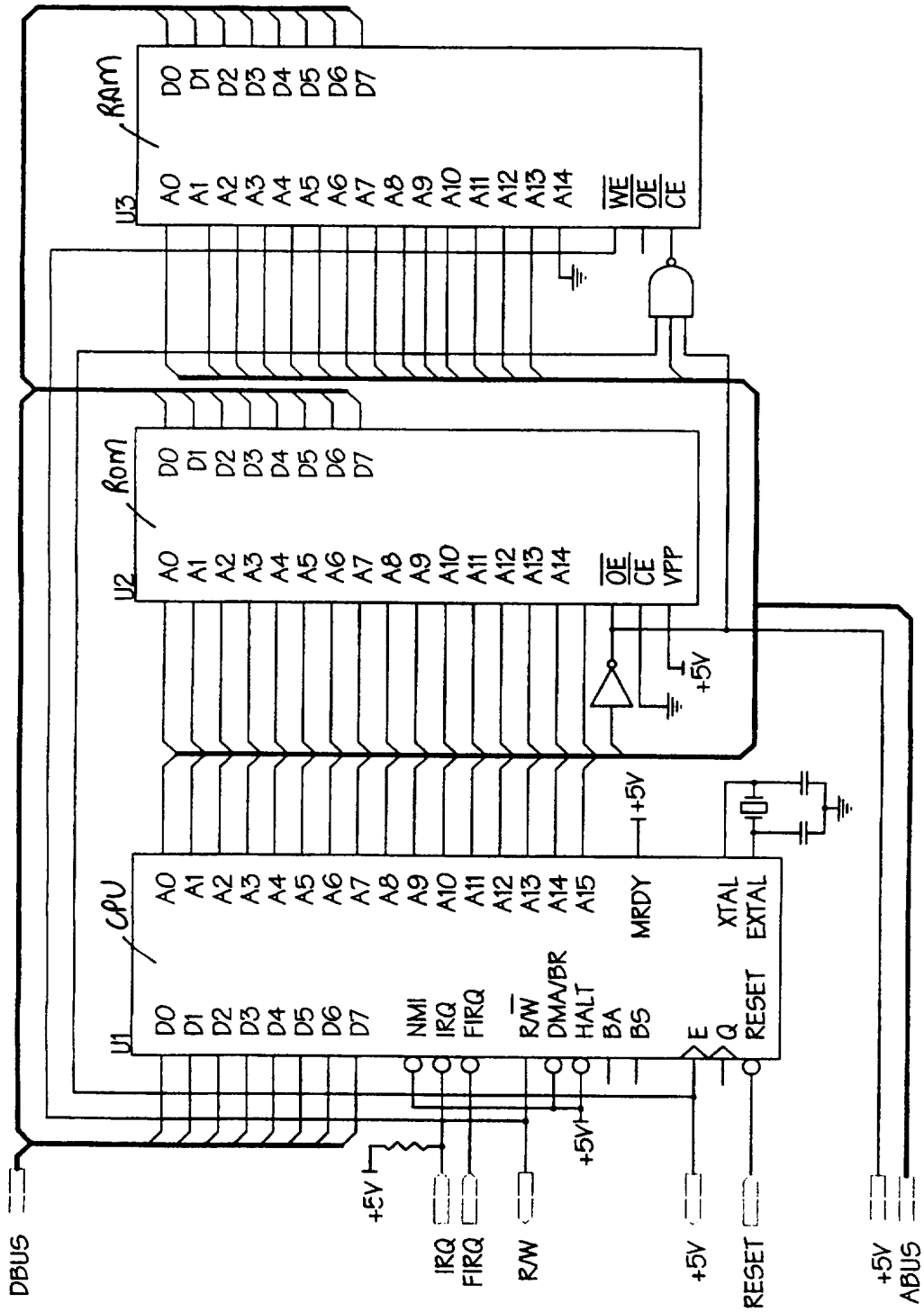

RAM
U3
D0 D1 D2 D3 D4 D5 D6 D7
A0 A1 A2 A3 A4 A5 A6 A7 A8 A9 A10 A11 A12 A13 A14
WE OE CE
ROM
U2
D0 D1 D2 D3 D4 D5 D6 D7
A0 A1 A2 A3 A4 A5 A6 A7 A8 A9 A10 A11 A12 A13 A14
OE CE VPP
+5V
CPU
U1
A0 A1 A2 A3 A4 A5 A6 A7 A8 A9 A10 A11 A12 A13 A14 A15
D0 D1 D2 D3 D4 D5 D6 D7
NMI IRQ FIRQ R/W DMA/BR HALT BA BS
MRDY
XTAL EXTAL
E Q RESET
+5V
DBUS
IRQ
FIRQ
R/W
+5V
RESET
+5V
ABUS

Fig 13A

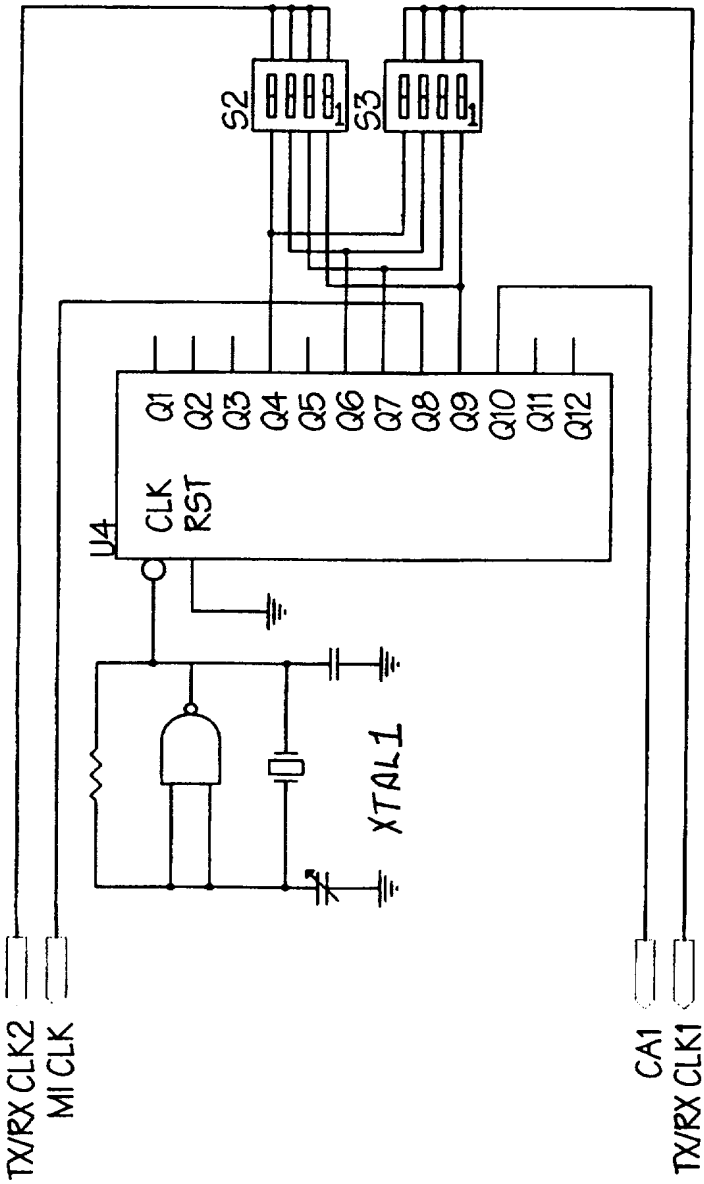

S2
S3
Q1
Q2
Q3
Q4
Q5
Q6
Q7
Q8
Q9
Q10
Q11
Q12
U4
CLK
RST
XTAL1
TX/RX CLK2
MI CLK
CA1
TX/RX CLK1

FIG 13B

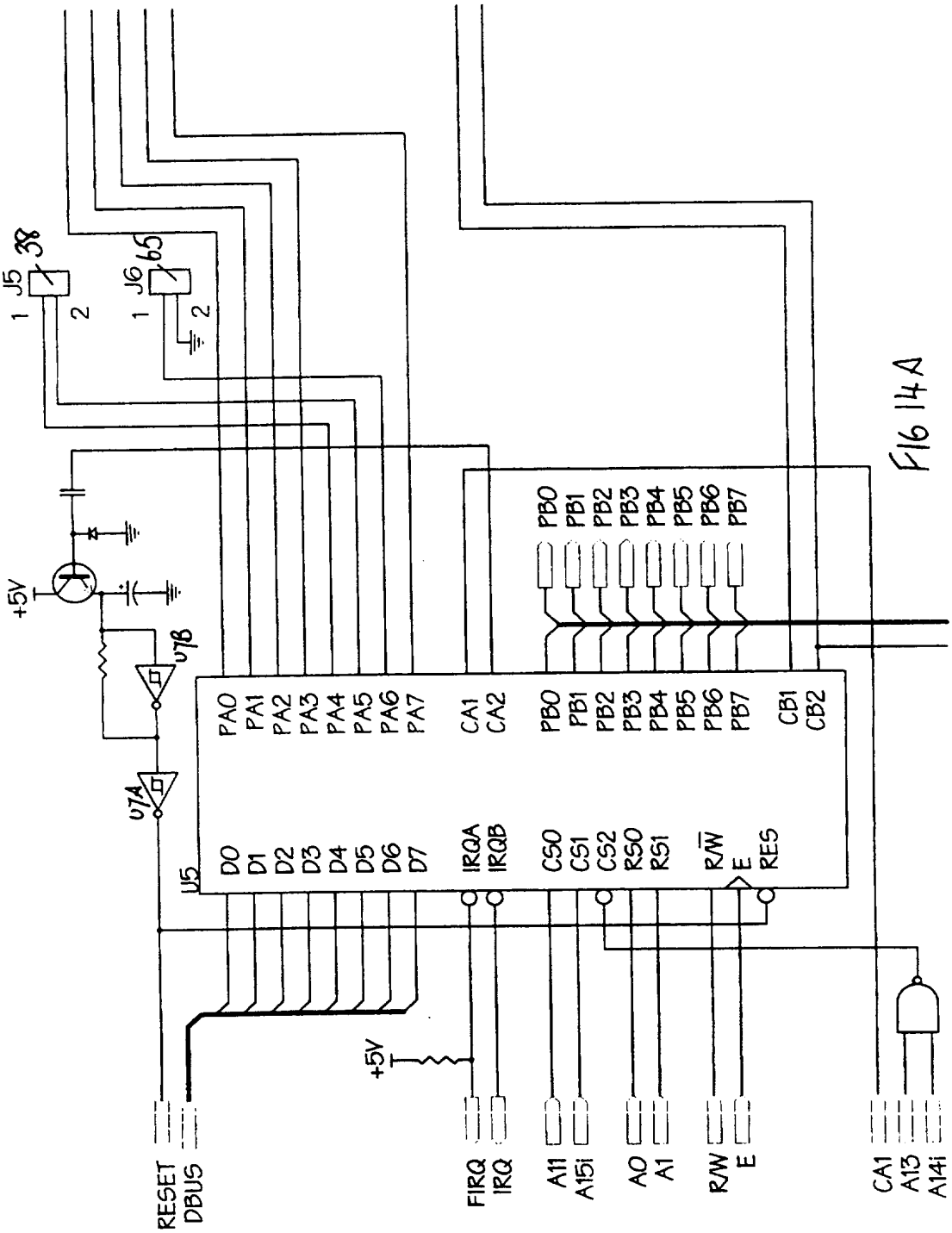

J5
38
J6
65
1
2
+5V
U7B
U7A
U5
PA0
PA1
PA2
PA3
PA4
PA5
PA6
PA7
CA1
CA2
PB0
PB1
PB2
PB3
PB4
PB5
PB6
PB7
CB1
CB2
D0
D1
D2
D3
D4
D5
D6
D7
IRQA
IRQB
CS0
CS1
CS2
RS0
RS1
R/W
E
RES
RESET
DBUS
FIRQ
IRQ
A11
A15i
A0
A1
R/W
E
CA1
A13
A14i

FIG 14A

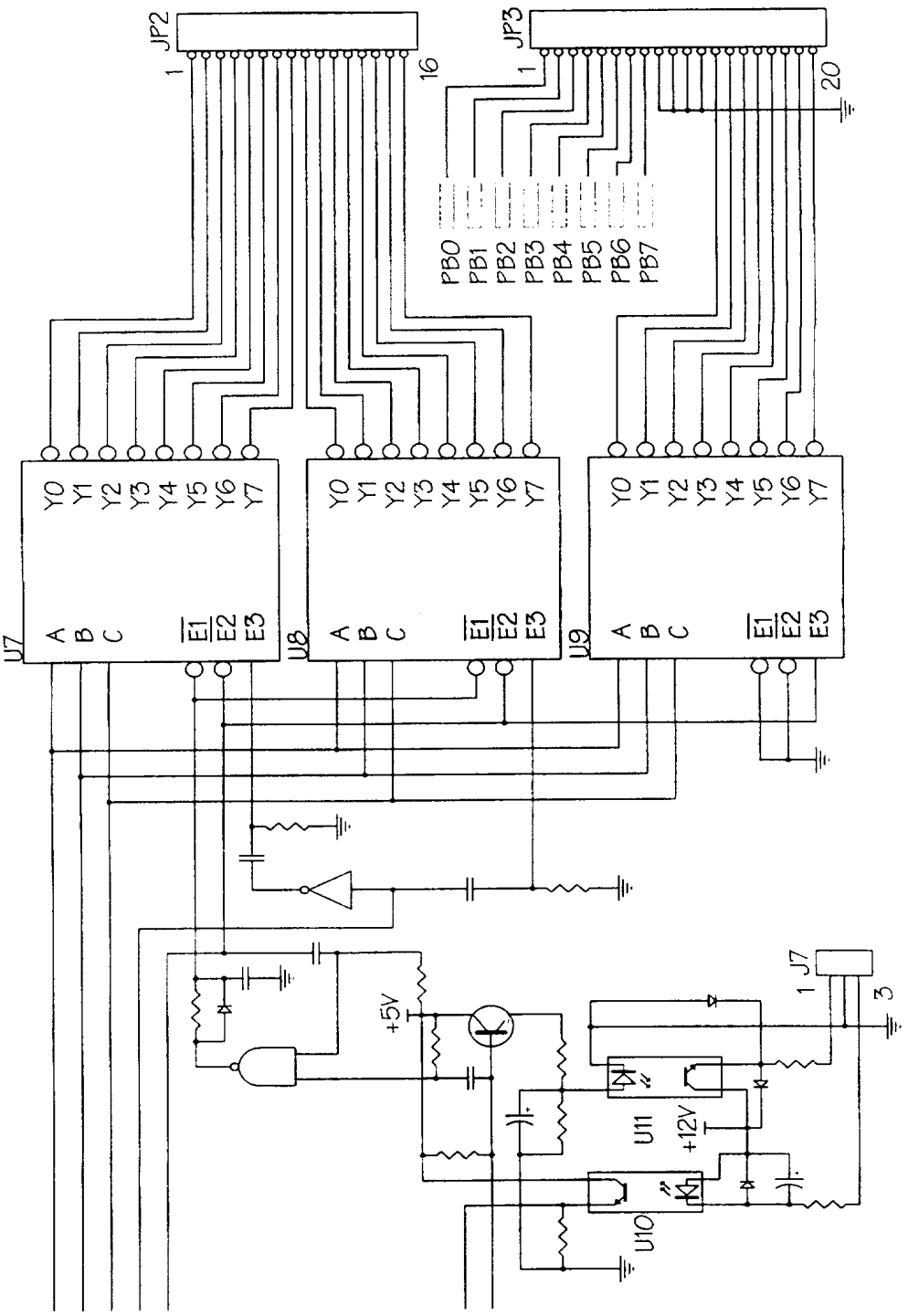
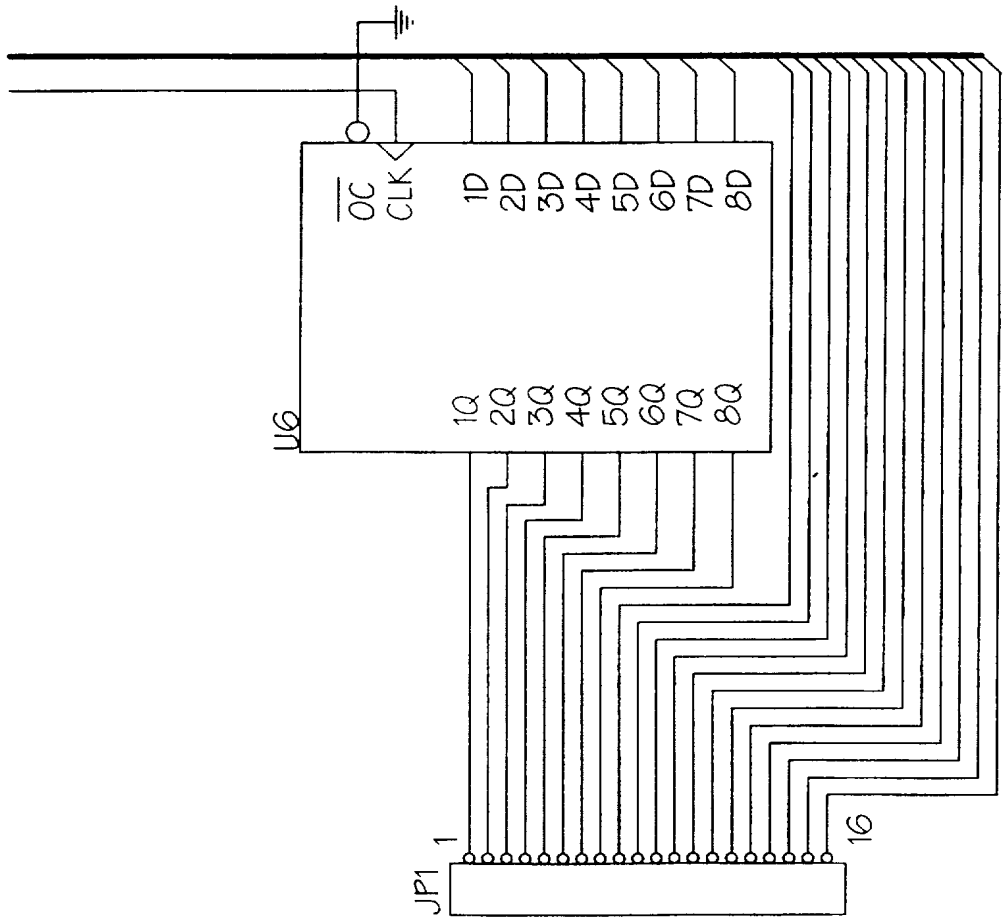

JP2
1
16
JP3
1
20
PB0
PB1
PB2
PB3
PB4
PB5
PB6
PB7
U7
U8
U9
Y0
Y1
Y2
Y3
Y4
Y5
Y6
Y7
A
B
C
E1
E2
E3
+5V
+12V
U10
U11
J7
1
3

FIG 14B

Fig 14C



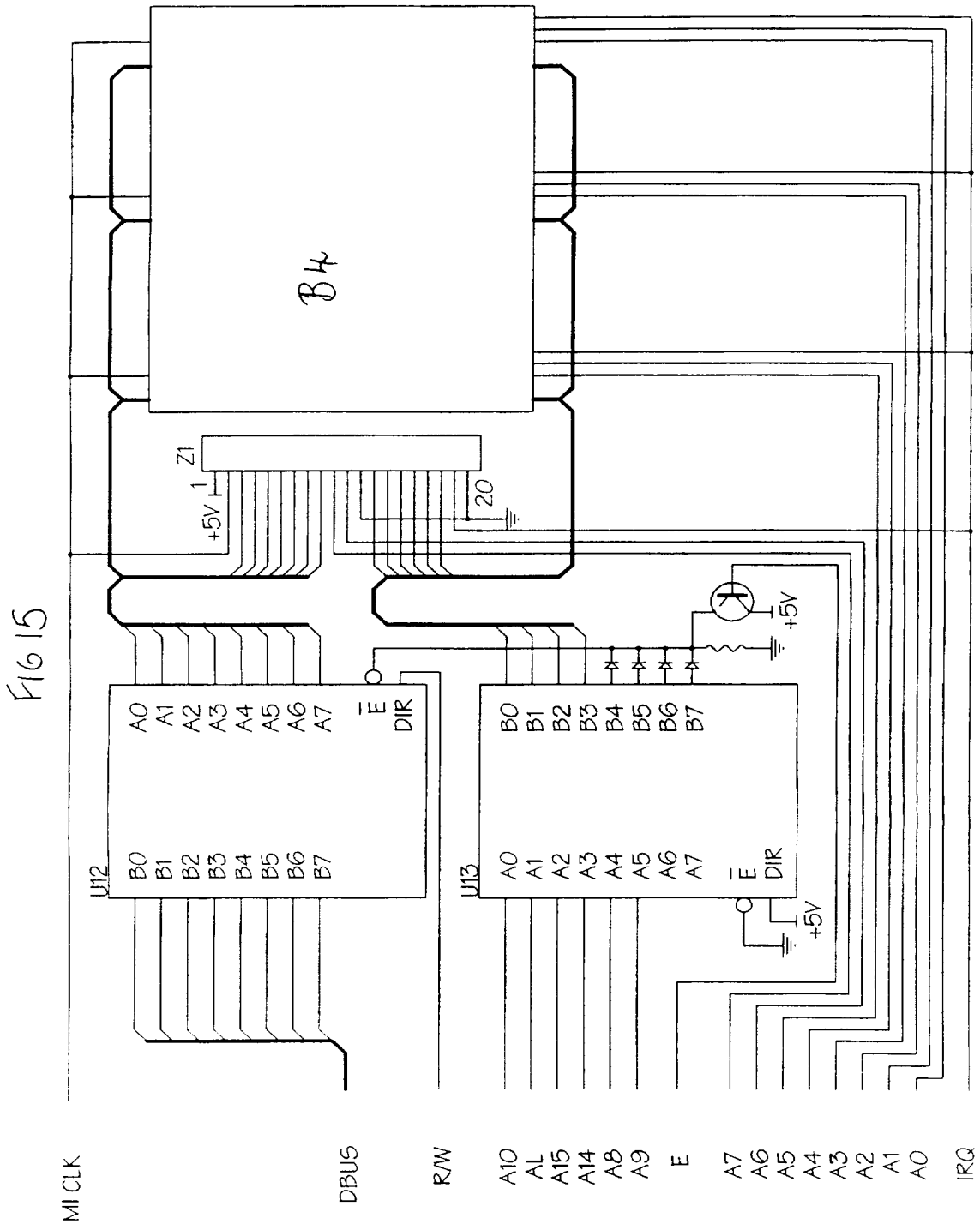

B4
Z1
+5V
1
20
U12
U13
A0
A1
A2
A3
A4
A5
A6
A7
B0
B1
B2
B3
B4
B5
B6
B7
E
DIR
+5V
MI CLK
DBUS
R/W
A10
AL
A15
A14
A8
A9
E
A7
A6
A5
A4
A3
A2
A1
A0
IRQ

Fig 15

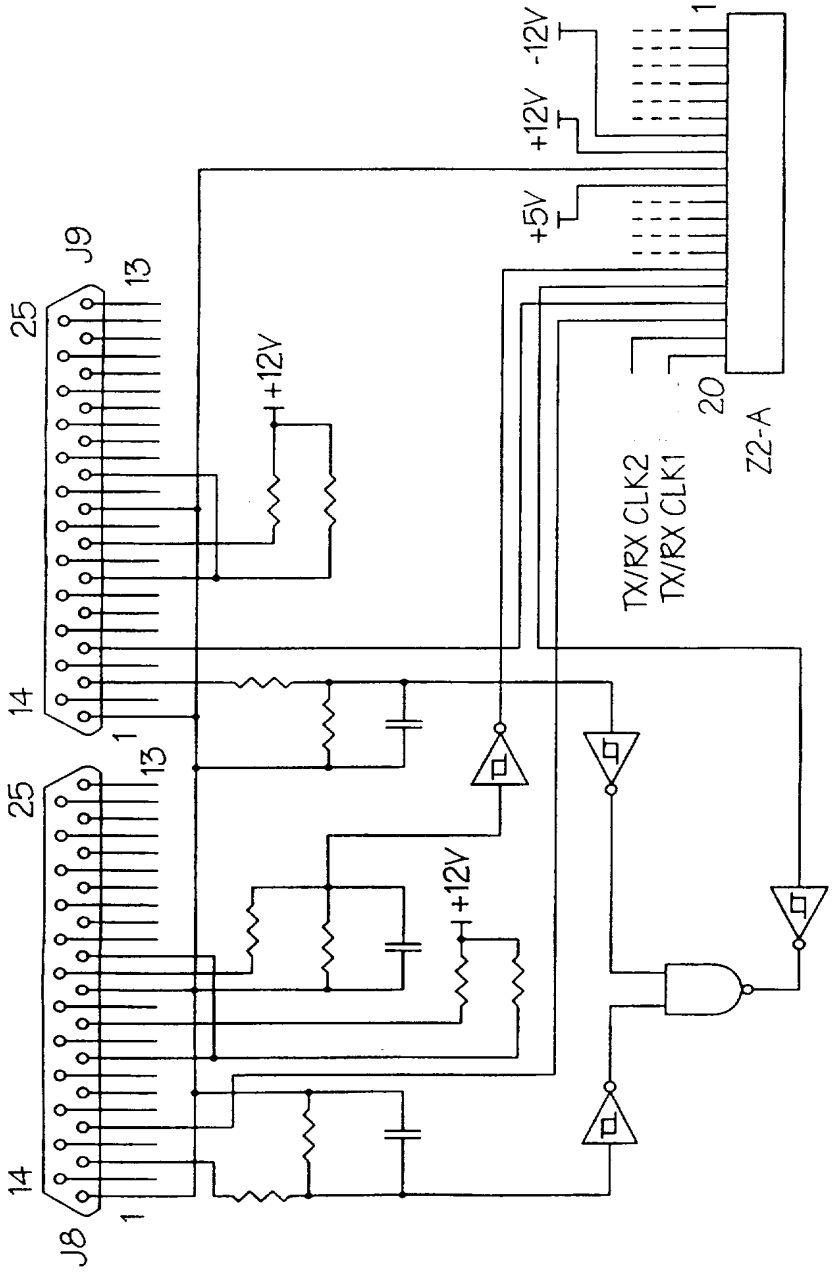


FIG 16A

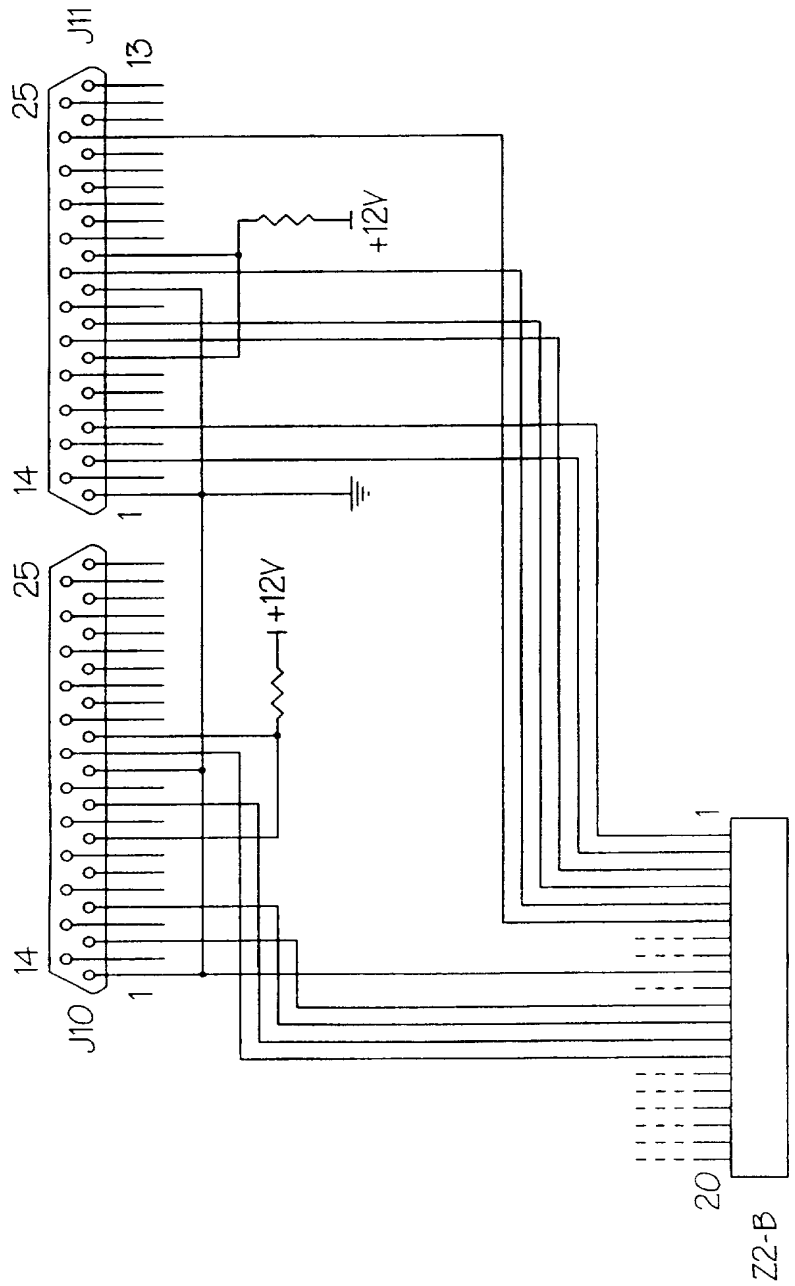


FIG 16B

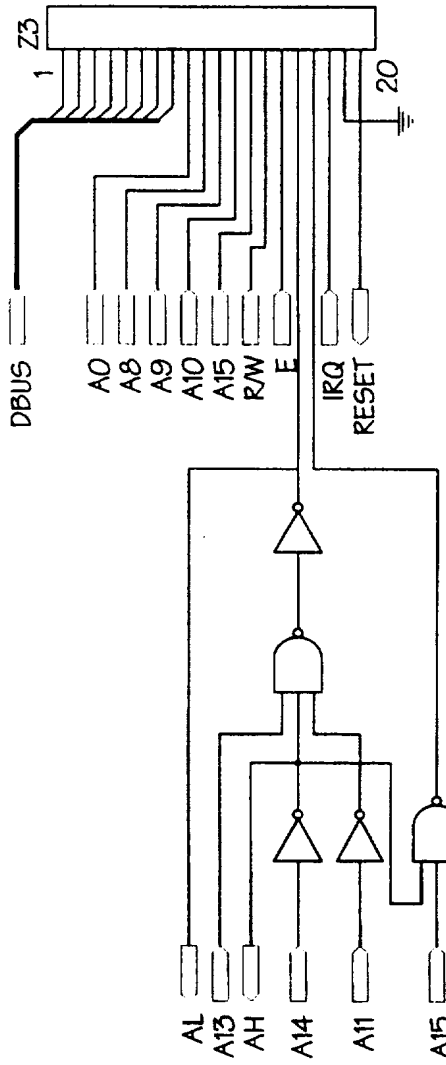
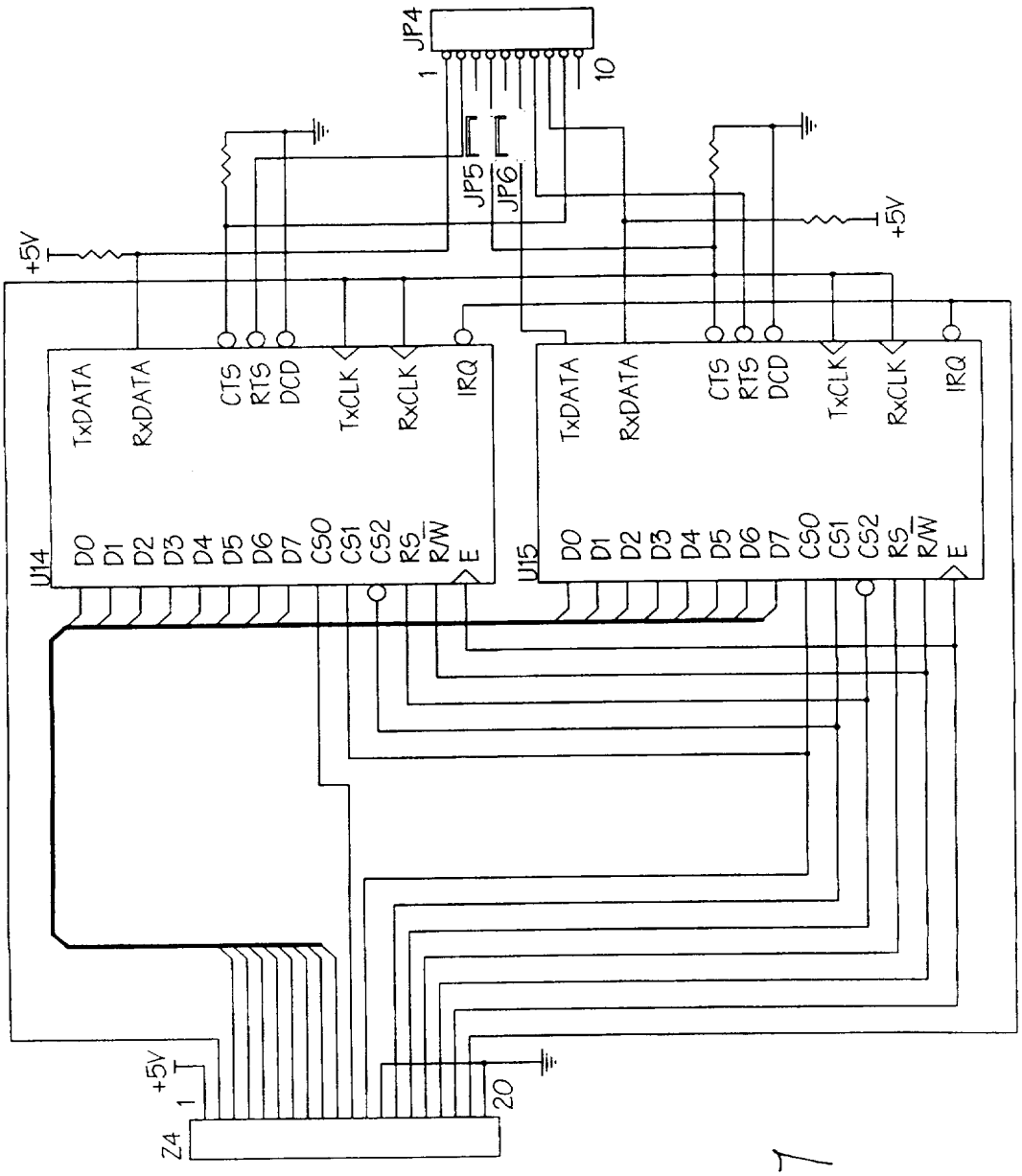

Z3
1
20
DBUS
A0
A8
A9
A10
A15
R/W
E
IRQ
RESET
AL
A13
AH
A14
A11
A15
A12

Fig 16c


JP4
1
10
JP5
JP6
+5V
+5V
TxDATA
RxDATA
CTS
RTS
DCD
TxCLK
RxCLK
IRQ
U14
U15
D0
D1
D2
D3
D4
D5
D6
D7
CS0
CS1
CS2
RS
R/W
E
+5V
1
Z4
20

F1617

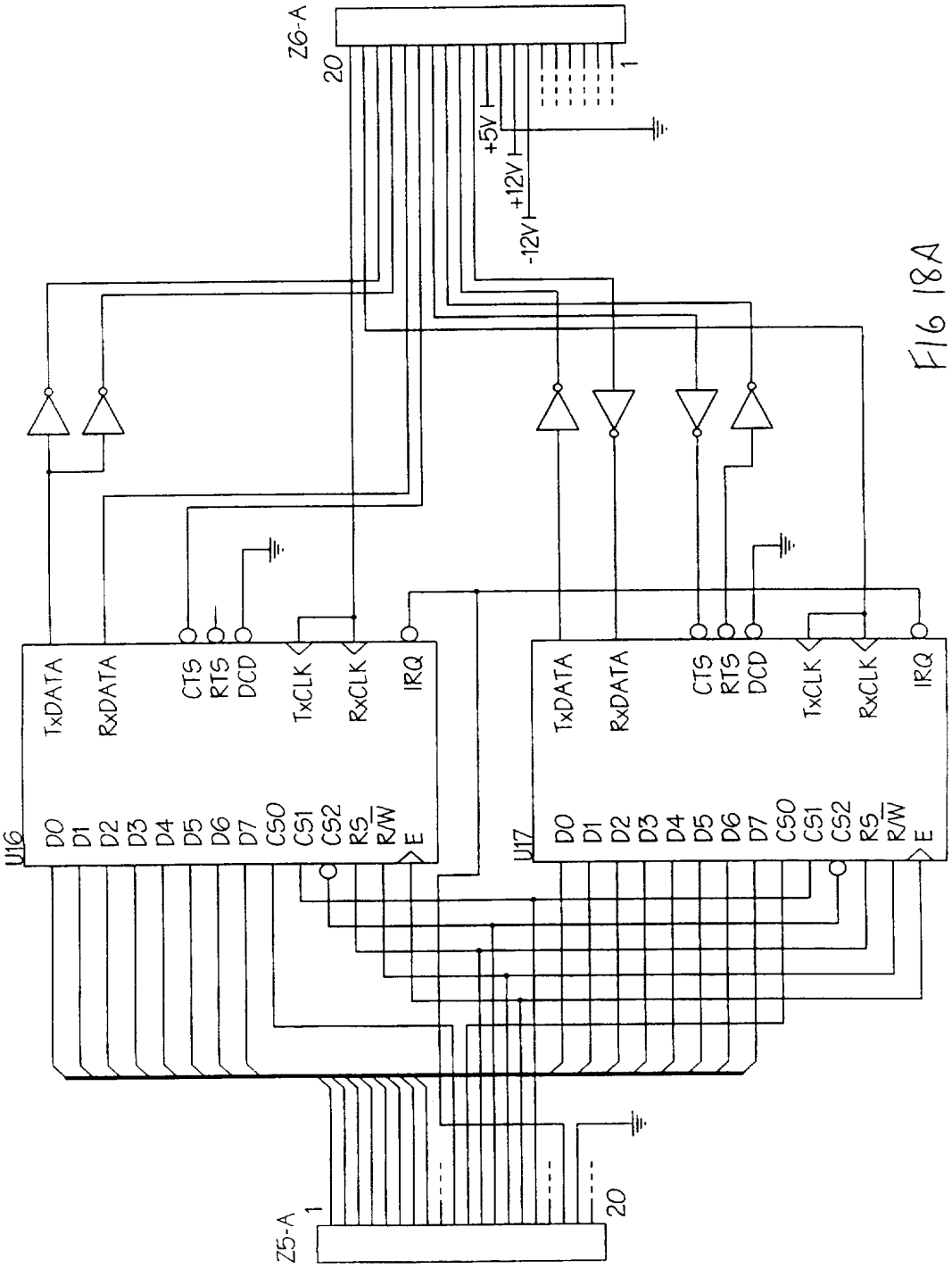

Z6-A
20
1
+5V
+12V
-12V
U16
U17
TxDATA
RxDATA
CTS
RTS
DCD
TxCLK
RxCLK
IRQ
D0
D1
D2
D3
D4
D5
D6
D7
CS0
CS1
CS2
RS
R/W
E
Z5-A
1
20

FIG 18A

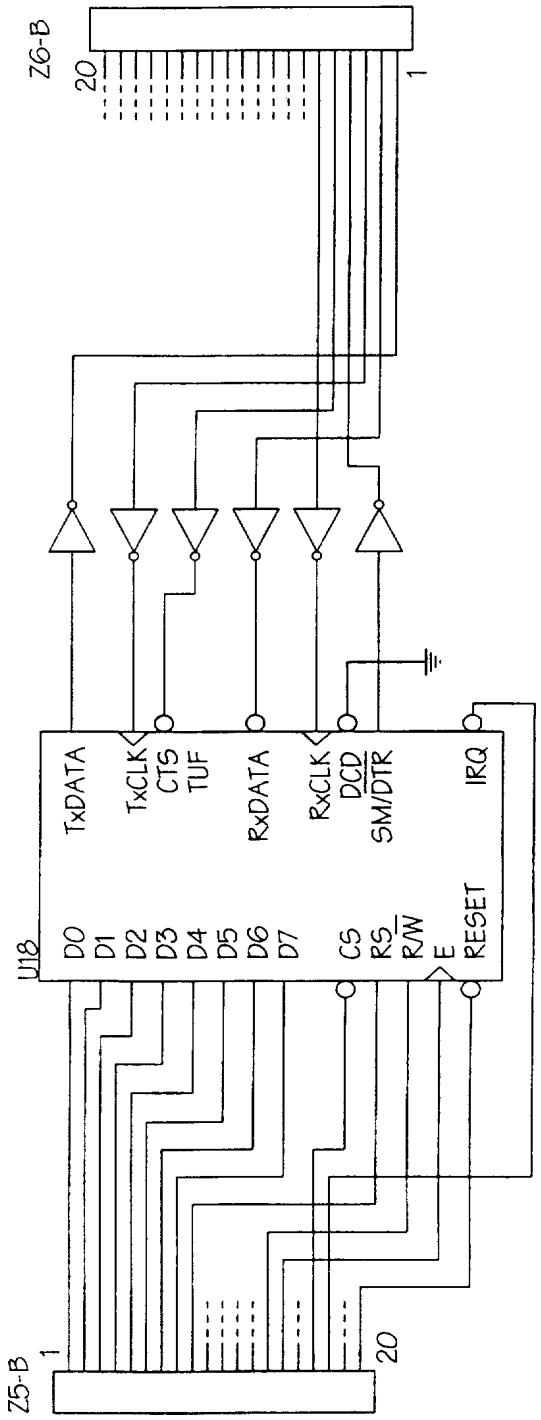
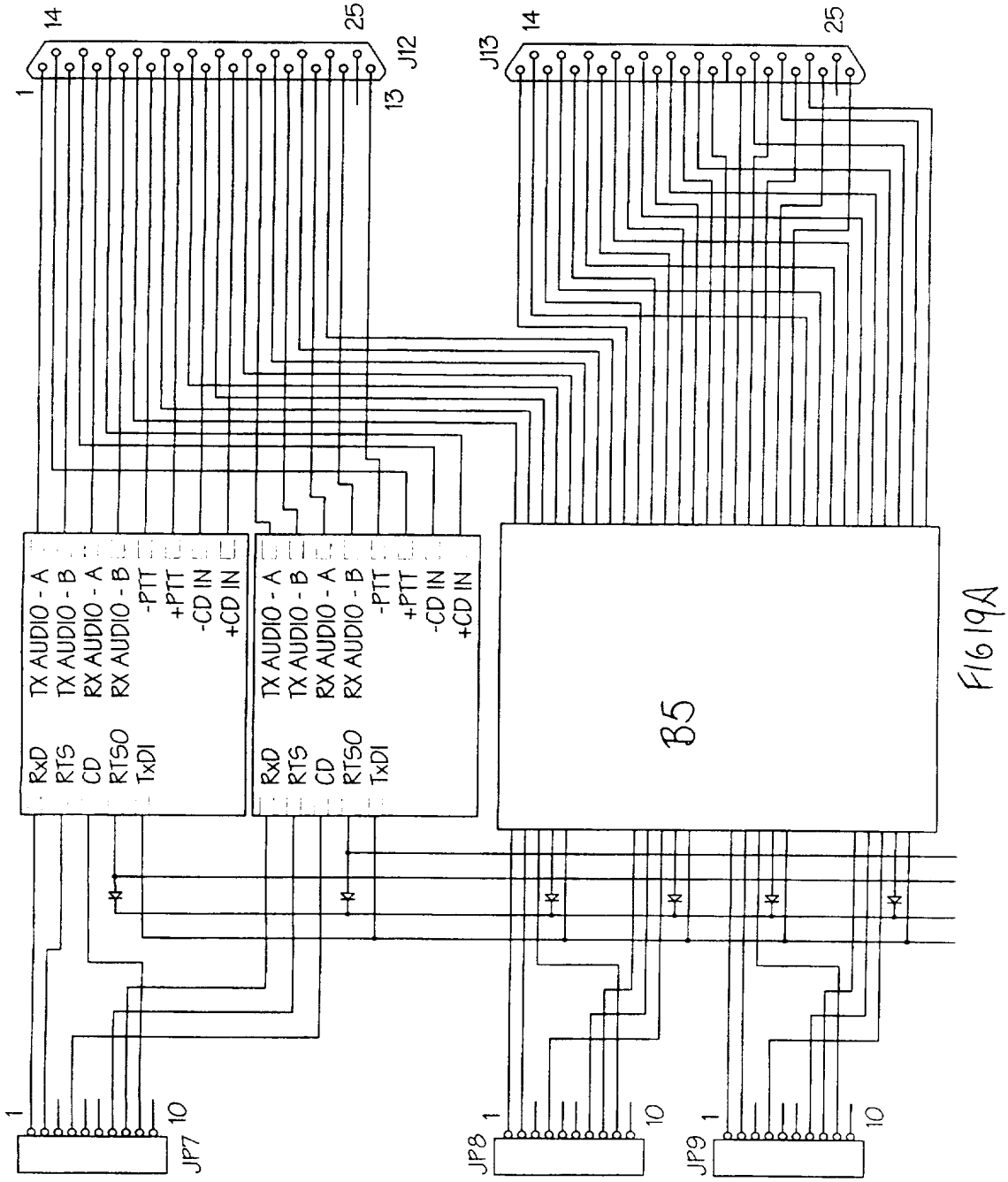

Z6-B
20
1
TxDATA
TxCLK
CTS
TUF
RxDATA
RxCLK
DCD
SM/DTR
IRQ
U18
D0
D1
D2
D3
D4
D5
D6
D7
CS
RS
R/W
E
RESET
Z5-B
1
20

FIG 18B


J12
J13
14
25
1
13
TX AUDIO - A
TX AUDIO - B
RX AUDIO - A
RX AUDIO - B
-PTT
+PTT
-CD IN
+CD IN
RxD
RTS
CD
RTSO
TxDI
B5
JP7
JP8
JP9
1
10

F16 19A

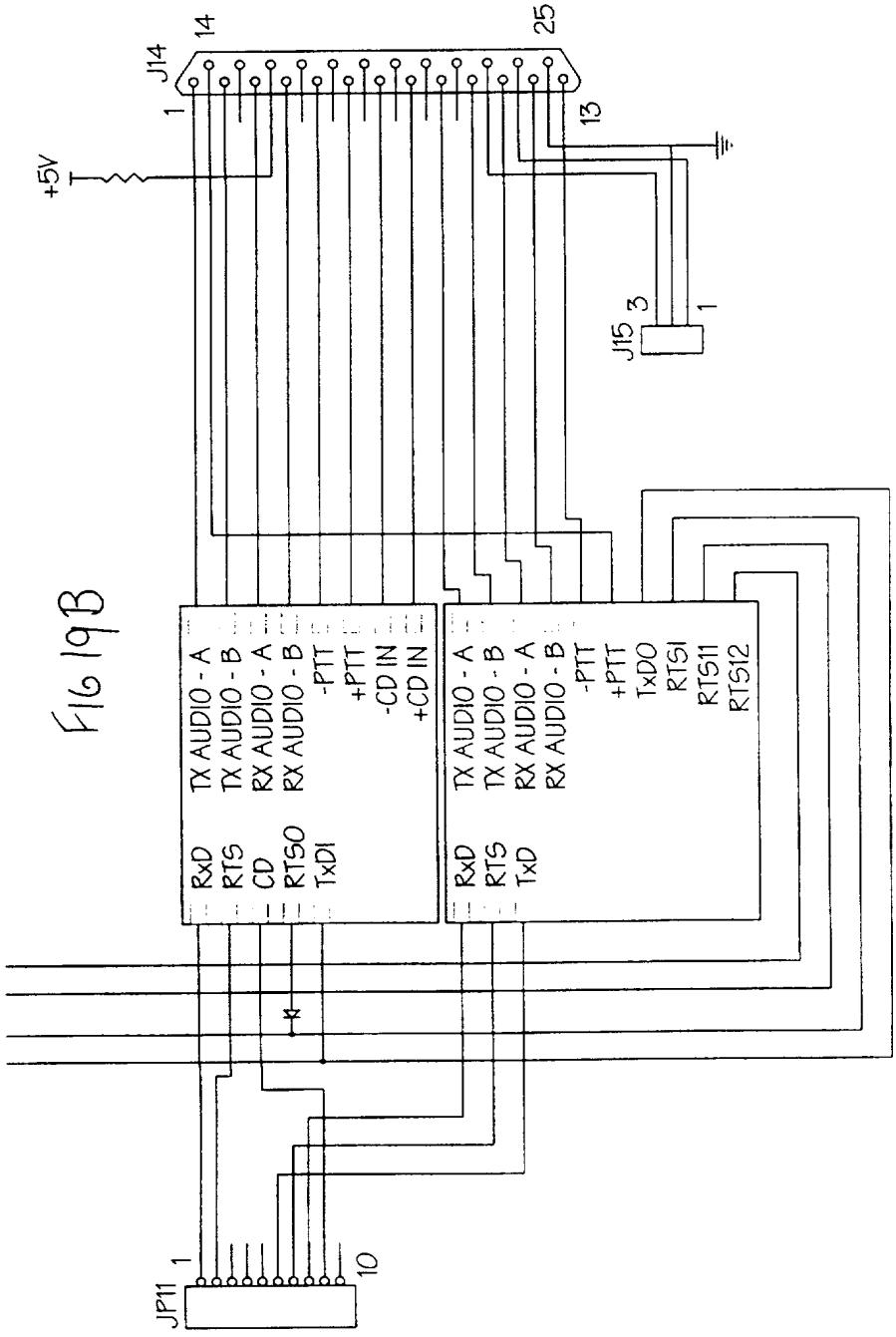

J14
14
25
1
13
+5V
J15
3
1
TX AUDIO - A
TX AUDIO - B
RX AUDIO - A
RX AUDIO - B
-PTT
+PTT
-CD IN
+CD IN
RxD
RTS
CD
RTSO
TxDI
TX AUDIO - A
TX AUDIO - B
RX AUDIO - A
RX AUDIO - B
-PTT
+PTT
TxDO
RTSI1
RTSI2
RxD
RTS
TxD
JP11
1
10

Fig 19B

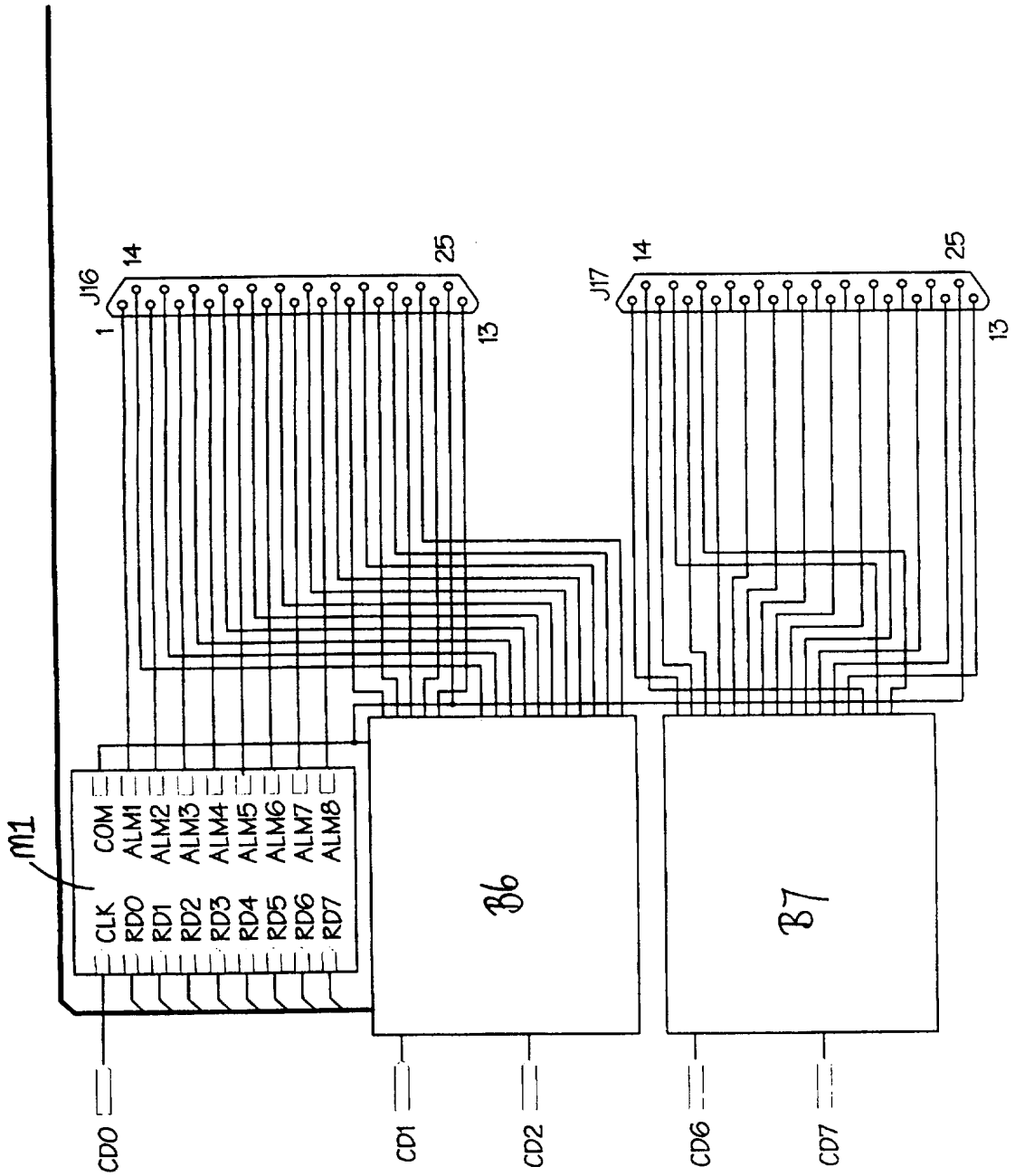

J16
14
25
1
13
J17
14
25
13
M1
COM
ALM1
ALM2
ALM3
ALM4
ALM5
ALM6
ALM7
ALM8
CLK
RD0
RD1
RD2
RD3
RD4
RD5
RD6
RD7
B6
B7
CD0
CD1
CD2
CD6
CD7

FIG 20A

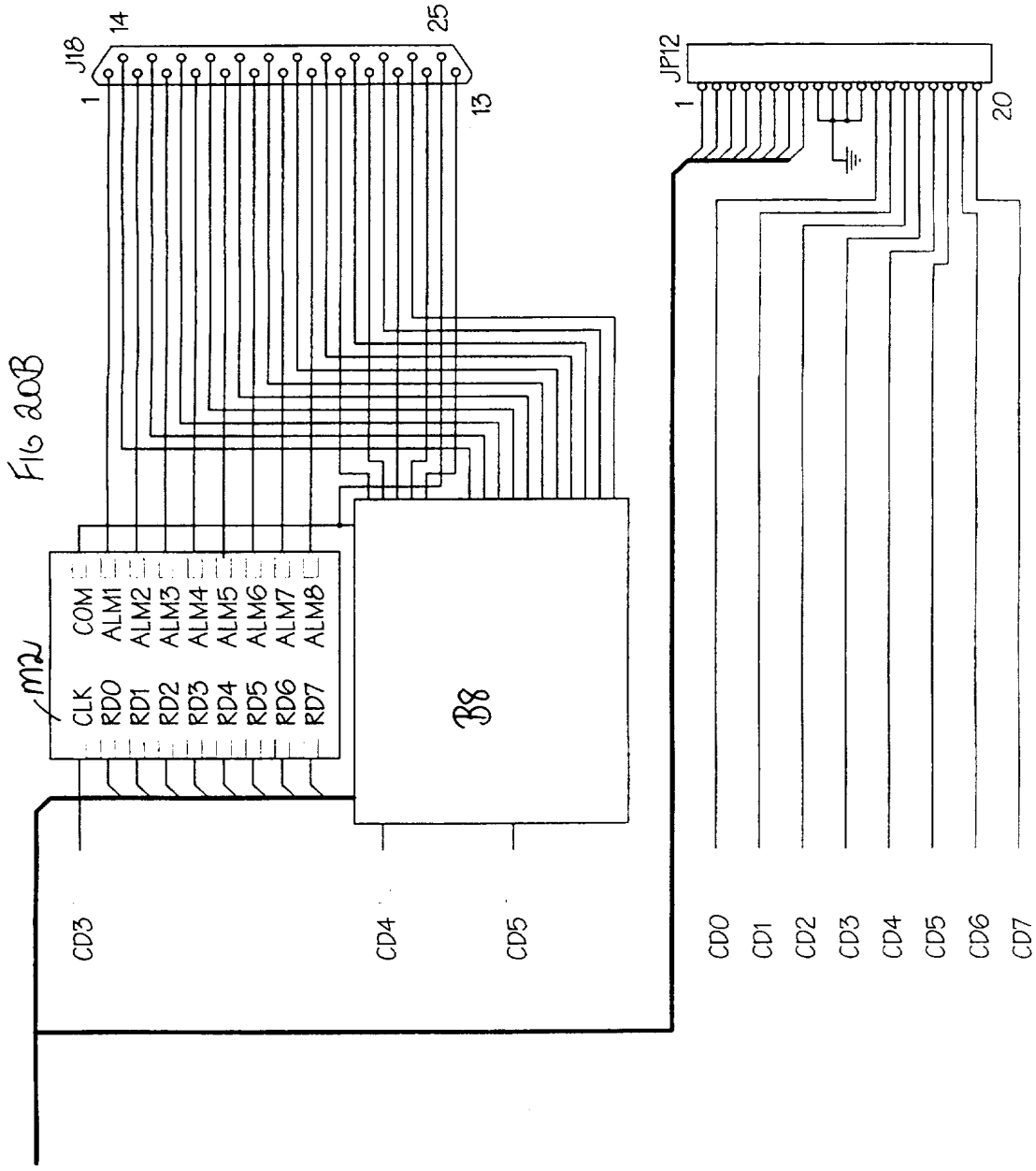

J18
1
14
25
13
JP12
1
20
M2
CLK
RD0
RD1
RD2
RD3
RD4
RD5
RD6
RD7
COM
ALM1
ALM2
ALM3
ALM4
ALM5
ALM6
ALM7
ALM8
B8
CD3
CD4
CD5
CD0
CD1
CD2
CD3
CD4
CD5
CD6
CD7

Fig 20B

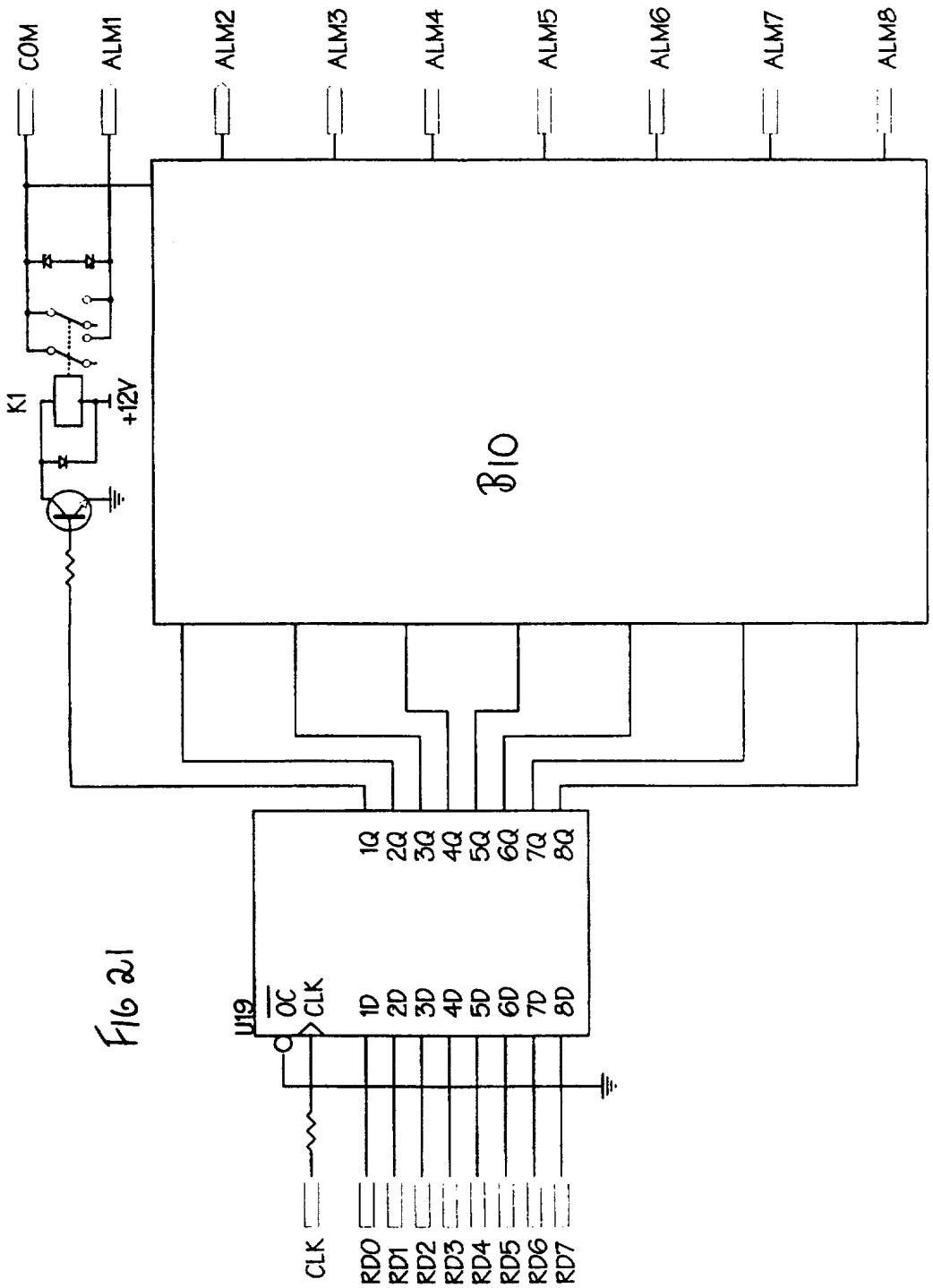

COM
ALM1
ALM2
ALM3
ALM4
ALM5
ALM6
ALM7
ALM8
K1
+12V
B10
U19
OC
CLK
1D
2D
3D
4D
5D
6D
7D
8D
1Q
2Q
3Q
4Q
5Q
6Q
7Q
8Q
CLK
RD0
RD1
RD2
RD3
RD4
RD5
RD6
RD7

Fig 21

INTERNATIONAL SEARCH REPORT

International Application No.
PCT/AU 97/00097

A. CLASSIFICATION OF SUBJECT MATTER

Int Cl[6]: B61L 27/04, 29/30; G08B 1/00, 7/00, 23/00, 26/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC : B61L 27/04, 29/30; G08B 1/00, 7/00, 23/00, 26/00

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
AU : IPC as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP, A2, 244384 (SOLLINGER, H.) 4 November 1987	1-20
X	US, A, 4511887 (FIORE) 16 April 1985	1-20
X	US, A, 4257038 (ROUNDS et al.) 17 March 1981	1-20
A	US, A, 4222052 (DUNN) 9 September 1980	
A	AU, B, 36125/78 (WARD, P.D.) 22 November 1979	
A	US, A, 4067008 (SPROWLS, J.B.) 3 January 1978	

☐ Further documents are listed in the continuation of Box C

☒ See patent family annex

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

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"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search
12 May 1997

Date of mailing of the international search report
23 MAY 1997

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Telephone No.: (06) 283 2204

INTERNATIONAL SEARCH REPORT
Information on patent family members

International Application No.
PCT/AU 97/00097

This Annex lists the known "A" publication level patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent Document Cited in Search Report		Patent Family Member					
EP	244384	CA	1277033	DE	3775976	JP	63032699
		US	4811011				
US	4511887	AU	89956/82	CA	1200846	WO	83/01139
		ZA	8206747				
US	4222052	AU	31575/77				

END OF ANNEX